DOD/VHA CLINICAL PRACTICE GUIDELINE
FOR THE MANAGEMENT OF

ASTHMA
FOR INFANTS AND CHILDREN UNDER 6 YEARS OLD WHO CANNOT PERFORM SPIROMETRY

Department of Defense
Veterans Health Administration

Prepared by:

THE MANAGEMENT OF ASTHMA

Working Group

With support from:

Quality Management Directorate, United States Army MEDCOM
&
The Office of Performance and Quality, VHA, Washington, DC
External Peer Review Program

Contractor:
RAND

Contract number: DASW01-96-C-0004

August, 1999
Version 1

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INTRODUCTION

VHA/DOD CLINICAL PRACTICE GUIDELINE FOR THE MANAGEMENT OF ASTHMA

Introduction

Asthma is a chronic inflammatory disease of the lungs characterized by episodic and reversible airway obstruction. In the United States, rates of asthma have been increasing over recent decades in all age and racial groups, from an average of 30.7 per thousand to 53.8 per thousand in 1994 (1). In 1998, asthma affected an estimated 17.3 million persons in the United States, including over 4.8 million children (2). Asthma mortality and morbidity have also been on the rise, with asthma accounting for more than 5000 deaths, 1.87 million emergency department visits, and over 100 million restricted activity days in 1995 (1).

With the appropriate use of available therapies, asthma exacerbations and their consequences can be effectively controlled. The purpose of this clinical practice guideline is to help clinicians and patients make appropriate decisions about asthma care. This guideline can assist primary care providers or specialists in the diagnosis and initial management of symptoms, follow-up management and assessment of the ongoing clinical situation, emergency management of acute exacerbations, determination of appropriate treatment, and delivery of individualized interventions. This guideline has been developed with a broad range of clinical settings in mind and should be applied with enough flexibility to accommodate local practice and individual situations.

Guideline Development Process

Since 1998, the selection of guideline topics and the guideline development process have been under the joint auspices of the Veterans Health Administration (VHA) and the Department of Defense (DoD) pursuant to directives from the Department of Veterans Affairs Undersecretary for Health and the DoD Assistant Secretary of Defense, Health Affairs. Asthma was selected based on its prevalence in the VHA and DoD populations, the risks that are associated with this condition, and the mitigating effects of early diagnosis and preventive treatment on the frequency and severity of asthma symptoms and mortality.

The guideline development process follows from the definition of clinical practice guidelines used by the VHA and DoD (3,4):

> Recommendations for the performance or exclusion of specific procedures or services derived through a rigorous methodological approach that includes the following:
>
> 1. Determination of appropriate criteria, such as effectiveness, efficacy, population benefit, or patient satisfaction; and
> 2. Literature review to determine the strength of the evidence in relation to these criteria.

This clinical practice guideline updates the 1997 version of the VHA Guideline on Management of Persons with Asthma, a guideline aimed at the management of adult patients. The current guideline consists of two sections: one on the management of asthma for adults and children 6 years and over and a second on the management of asthma for infants and children under 6. The goal in developing this guideline was to incorporate information from existing, national recommendations into a format, which would maximally facilitate clinical decision-making (5). This effort drew heavily from the National Heart, Lung and Blood Institute's National Asthma Education and Prevention Program Expert Panel Report 2, *Guidelines for the Diagnosis and Management of Asthma*, published in July 1997 (6).

The 1997 guideline was the product of a research and consensus building effort among professionals from throughout the VHA. Work on this updated guideline for the Management of Asthma was started in November 1998, at a meeting that also updated a companion guideline, the Management of Chronic Obstructive Pulmonary Disease. The expert panel convened in 1998 included new participants from the DoD, VHA and academia as well as many of those involved with the 1997 VHA asthma guideline and a team of private guideline facilitators. An experienced moderator facilitated the multidisciplinary panel (including internists, family practitioners, pediatricians, pulmonologists, allergists, nurse practitioners, physician assistants, nurses, pharmacists, and health educators) in developing an updated asthma guideline appropriate for adults and children old enough to cooperate with spirometry. A smaller group of experts and primary care providers who work with infants and young children spent an additional day adapting the asthma guideline for use with children too young for spirometry. The process is evidence-based whenever possible. Where evidence is ambiguous or conflicting, or where scientific data are lacking, the clinical experience within the room was used to guide the development of consensus-based recommendations.

The clinical experts subjected all decision points in the algorithm to simulation exercises. A variety of hypothetical "patients" were run through the algorithm to test whether it was likely to work in a real clinical situation. Whenever an irregularity was encountered, changes were made. The clinical experts are thus reasonably confident that the algorithm will prove to be useful in real clinical encounters.

We are confident that the current guideline represents a significant step forward for primary health care in the DoD and VHA by promoting evidence-based management for persons with asthma. However, it is only the first step in the mission to improve the care of those with asthma. In the future, the challenges will be in:

- Guideline implementation
- Guideline promotion
- Development of teaching tools for graduate and continuing medical education
- Development of automation tools that include:
  - Provider specific report cards
  - Performance monitors that assist the practitioner/facility in outcome tracking based on guideline use.

Clinical guideline algorithms provide a basis for local development of more specific clinical pathways. Pathways are clinical management tools that organize, sequence, and specify the timing for the major patient care activities and interventions of the entire interdisciplinary team for a particular diagnosis or procedure. Clinical pathways define key processes and events in the day-to-day management of care and often serve as a component of the patient record. Variance from the pathway along with causes of divergence should be documented. Clinical pathways should be developed locally, as they are specific to the particular setting where utilized.

The system-wide goal is to improve local management of patients with asthma and thereby improve patient outcomes. The guideline/algorithms are designed to be adapted to an individual facility's needs and resources. They will also be updated periodically or when relevant research results become available. The guideline should be used as a starting point for innovative plans that improve collaborative efforts and focus on key aspects of care.

The clinical practice guideline is presented in an algorithmic format. There are indications that this format improves data collection and clinical decision-making and helps to change patterns of resource use. A clinical algorithm is a set of rules for solving a clinical problem in a finite number of steps. It allows the practitioner to follow a linear approach to the recognition and treatment of asthma. It is recognized, however, that clinical practice often requires a nonlinear approach, and must always reflect the unique clinical issues in an individual patient-provider situation. The use of guidelines must always be considered as a recommendation within the context of a provider's clinical judgment in the care for an individual patient.

A clinical algorithm diagrams a guideline into a step-by-step decision tree. The steps in this tree are represented as a sequence of actions (rectangle "do boxes") and questions (hexagonal "decision boxes"). A letter within a box of an algorithm refers the reader to the corresponding annotation. The annotations elaborate on the recommendations and statements that are found within each box of the algorithm. These annotations include a reference, when required, and evidence grading for each recommendation. The strength of the recommendation (SR) and the level of the evidence (LE) are both noted. The reference list at the end of each annotation includes all the sources used—directly or indirectly—in the development of the annotation text. A complete bibliography is provided at the end of the document.

Literature

The literature supporting the decision points and directives in this guideline is referenced throughout the document. Because this guideline is an update of the VHA asthma guideline developed in 1997, the literature search in support of the update focused on literature published after 1996 related to the population being studied (adults and children) and the treatment setting (primary care). Queries were developed under the guidance of members of the DoD/VHA expert panel.

The search was carried out using the National Library of Medicine's (NLM) MEDLINE database. The Medical Subject Headings (MeSH) included: (Diseases; Respiratory Tract Diseases; Respiratory Tract Diseases - Bronchial Diseases; Respiratory Tract Diseases - Respiratory Hypersensitivity; Lung Diseases; Lung Diseases - Obstructive; Immunologic

Diseases - Hypersensitivity, Immediate - Respiratory Hypersensitivity; Asthma). Selection of articles was then based on key therapies in asthma, study characteristics, and study design.

The literature search was followed by critical analysis of the literature, primarily by the clinical experts. To promote an evidence-type approach, the quality of evidence was rated using a hierarchical rating scheme. The value of a hierarchical rating scheme is that it provides a systematic means for evaluating the scientific basis for health care services (7). The rating scheme used for this guideline is based on a system used by the Agency for Health Care Policy and Research. Decision points in the algorithm are annotated, and the primary source documents for the annotation are graded. The grading schemes used for this guideline are:

STRENGTH OF RECOMMENDATION GRADING (8)

Grade	***Strength of Recommendation***
1	Usually indicated, always acceptable, and considered useful and effective.
2a	Acceptable, of uncertain effectiveness, and may be controversial. Weight of evidence in favor of usefulness/effectiveness.
2b	Acceptable, of uncertain effectiveness, and may be controversial. Not well established by evidence, can be helpful and probably not harmful.

LEVEL OF EVIDENCE GRADING

	Level of Evidence Grading = A	***Level of Evidence Grading = B***	***Level of Evidence Grading = C***
Primary Evidence	Randomized clinical trials	Well-designed clinical studies	Panel consensus
Secondary Evidence	Other clinical studies	Clinical studies related to topic but not in this clinical population	Clinical studies related to topic but not in this clinical population

Performance Measurement

The inability of consumers and health care purchasers to determine if medical care is appropriate and effective has given rise to the concept that the health care system should be held accountable for what is done and the outcomes achieved. This principle of accountability has resulted in the development of so-called "performance and outcome measures," administered through "report card" systems. Measures must be seen as fair and reasonable, and able to be carried out in various practice settings.

Performance measures are indicators or tools to assess the level of care provided to populations of patients. The measures are constructed to make the best use of the evidence available for assessing care or outcomes in systems where patient characteristics (e.g. co-morbidity) and compliance cannot be easily determined and taken into consideration (i.e. the measures are not case-mix adjusted). Along with the work on guideline development, both VHA and DoD are developing and disseminating companion performance measures.

Overview of the Guideline

This guideline consists of eight modules divided into two major sections: management of asthma for adults and children 6 years and over (A1a-A4a) and management of asthma for children under 6 (A1p-A4p).

1. Asthma diagnosis and initial management for adults and children age 6 years and over (A1a)
2. Asthma treatment follow-up management for adults and children age 6 years and over (A2a)
3. Asthma emergency management for adults and children age 6 years and over (A3a)
4. Asthma telephone triage management for adults and children age 6 years and over (A4a)
5. Asthma diagnosis and initial management for infants and children under 6 years old who cannot perform spirometry (A1p)
6. Asthma treatment follow-up management for infants and children under 6 years old who cannot perform spirometry (A2p)
7. Asthma emergency management for infants and children under 6 years old who cannot perform spirometry (A3p)
8. Asthma telephone triage management for infants and children under 6 years old who cannot perform spirometry (A4p)

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(1) Forecasted State-Specific Estimates of Self-Reported Asthma Prevalence – United States, 1998. *MMMR Weekly*, December 04, 1998; 47(47):1022-1025.

(2) Mannino DM; Homa DN; Pertowski CA; Ashizawa A; Nixon LL; Johnson CA; Ball LB; Jack E; Kang DS. Surveillance for Asthma – United States, 1960-1995. *MMMR Weekly*, April 24, 1998; 47(SS-1):1-28.

(3) VHA Directive 96-053. *Roles and Definitions for Clinical Practice Guidelines and Clinical Pathways*. August 29, 1996.

(4) VA Health Services Research and Development Service Management Decision and Research Center. *Clinical Practice Guidelines: Guidelines Primer*. Boston, MA. VA HSR&D 1998.

(5) Woolf SH. (May 1992) Practice guidelines, a new reality in medicine II: Methods of developing guidelines. *Archives of Internal Medicine* 1992; 152:947-948.

(6) *Guidelines on the Diagnosis and Management of Asthma: Expert Panel Report 2,* National Asthma Education and Prevention Program, National Heart, Lung, and Blood Institute. NIH Publication No. 97-4051, July, 1997.

(7) Woolf SH; DiGuiseppi CG; Atkins D; Kamerow DB. Developing evidence-based clinical practice guidelines: Lessons learned by the U.S. Preventive Services Task Force. *Ann Rev Pub Health* 1996; 17:511-38.

(8) Modified by Birch & Davis Associates, Inc. from: *AHCPR Clinical Practice Guideline No. 10. Unstable Angina: Diagnosis and Management*. March, 1994:12

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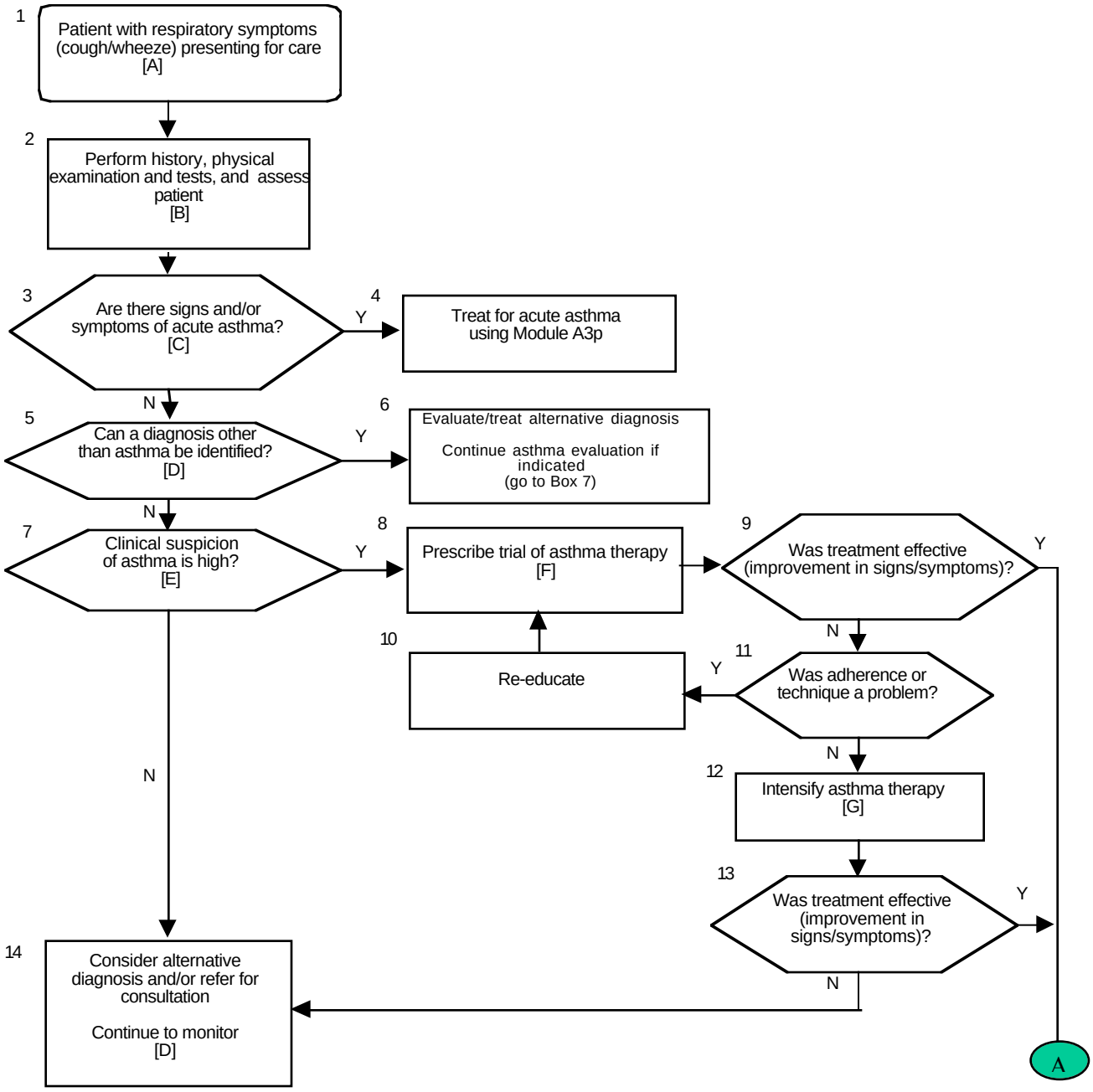
ALGORITHMS

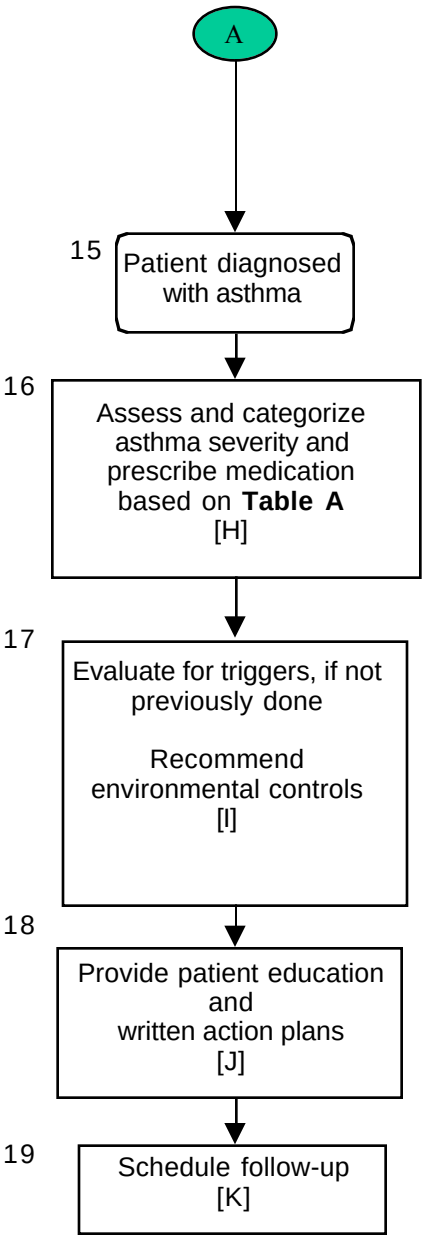
Algorithm A1p: 1 of 2

Asthma Diagnosis and Initial Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



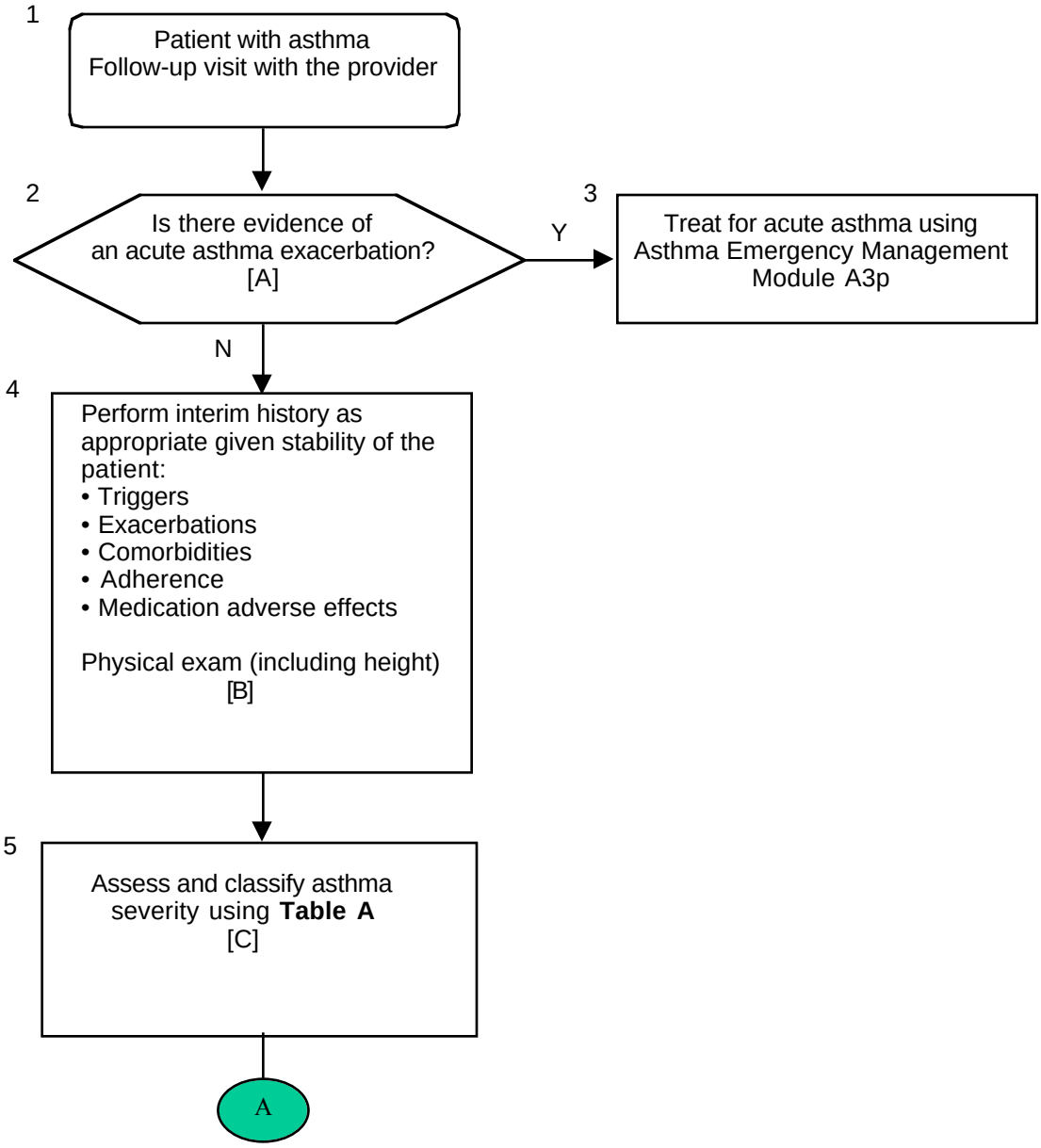
Algorithm A1p: 2 of 2

Asthma Diagnosis and Initial Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



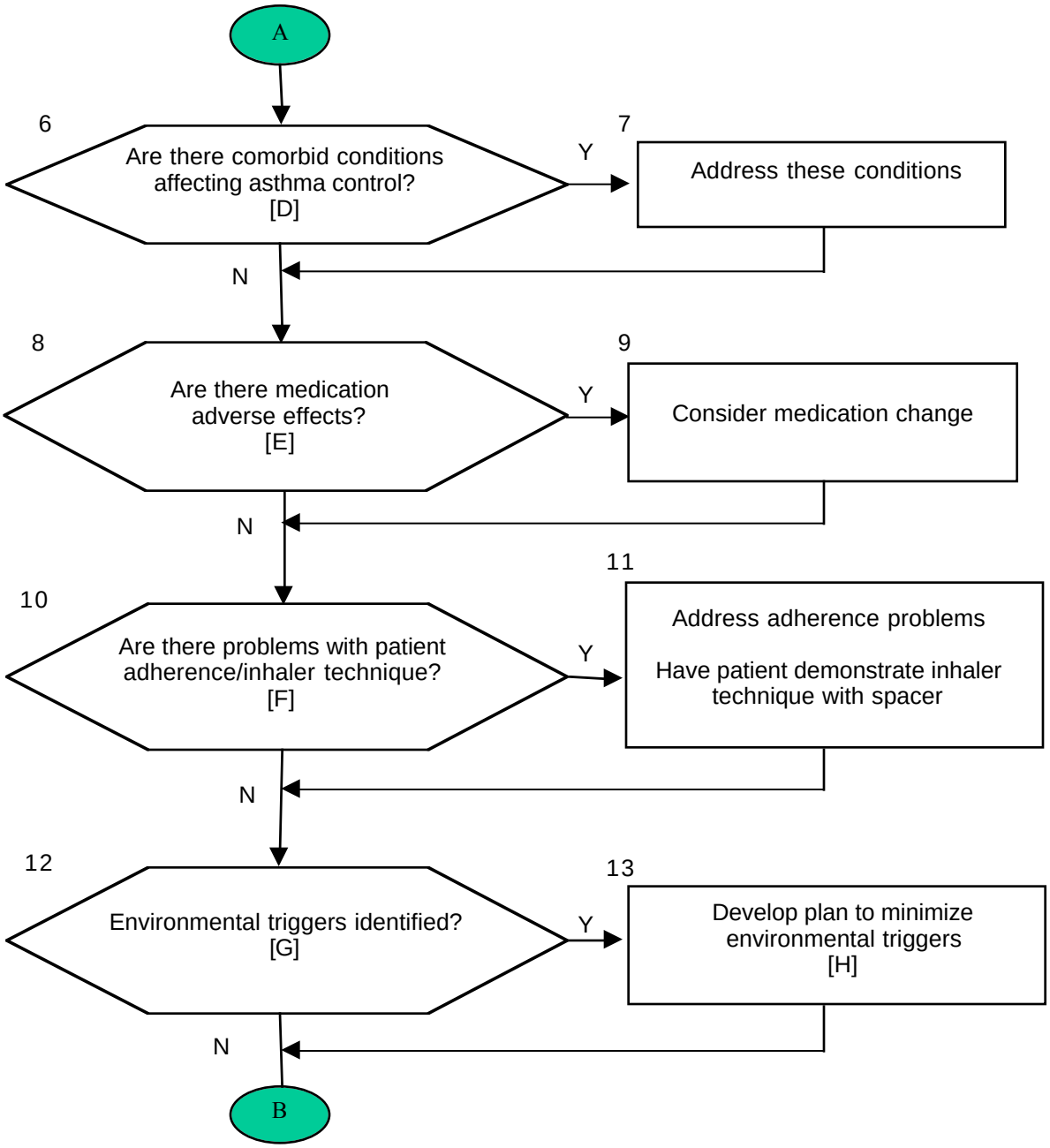
Algorithm A2p: 1 of 3

Asthma Treatment Follow-Up Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



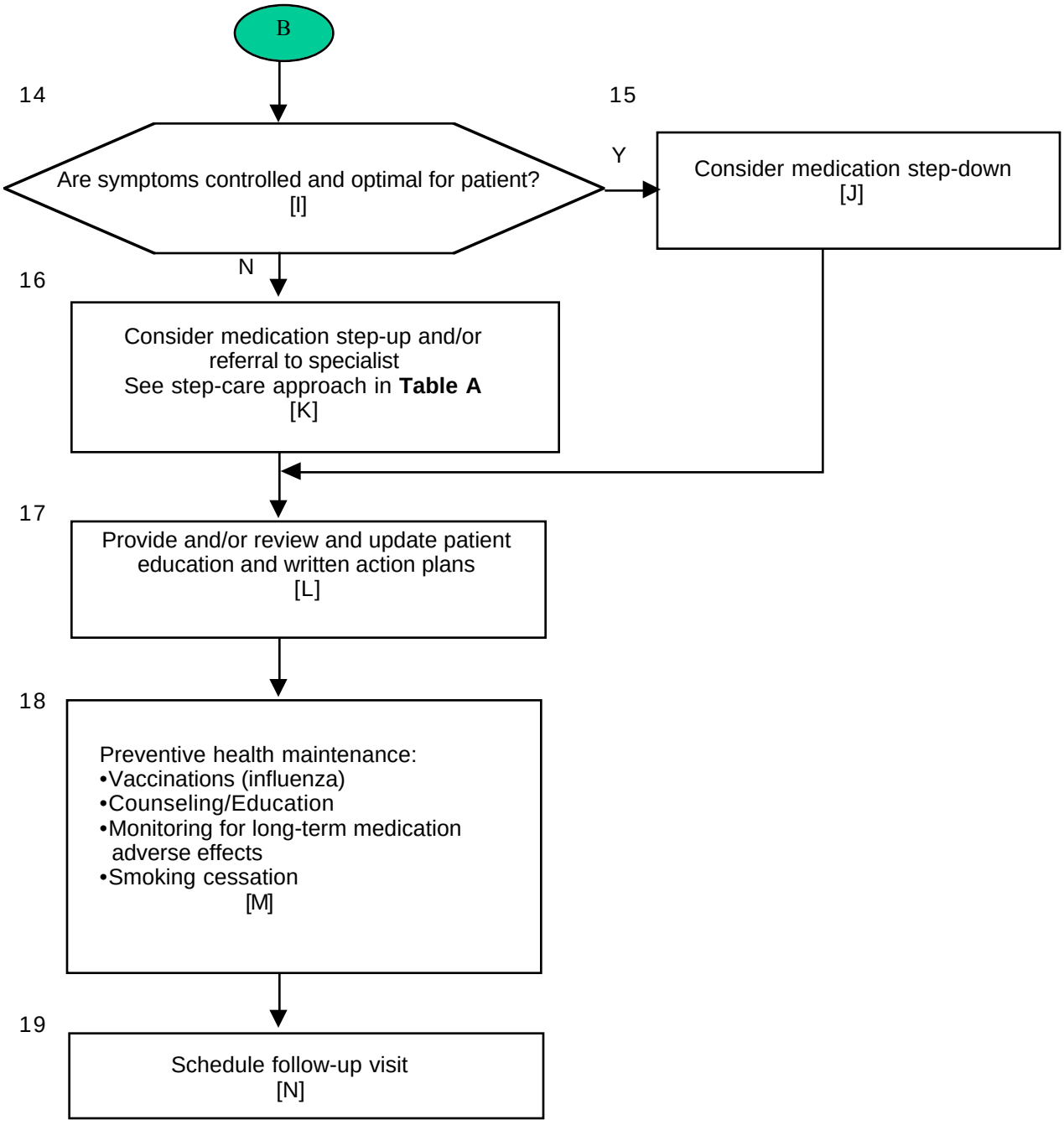
Algorithm A2p: 2 of 3

Asthma Treatment Follow-Up Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



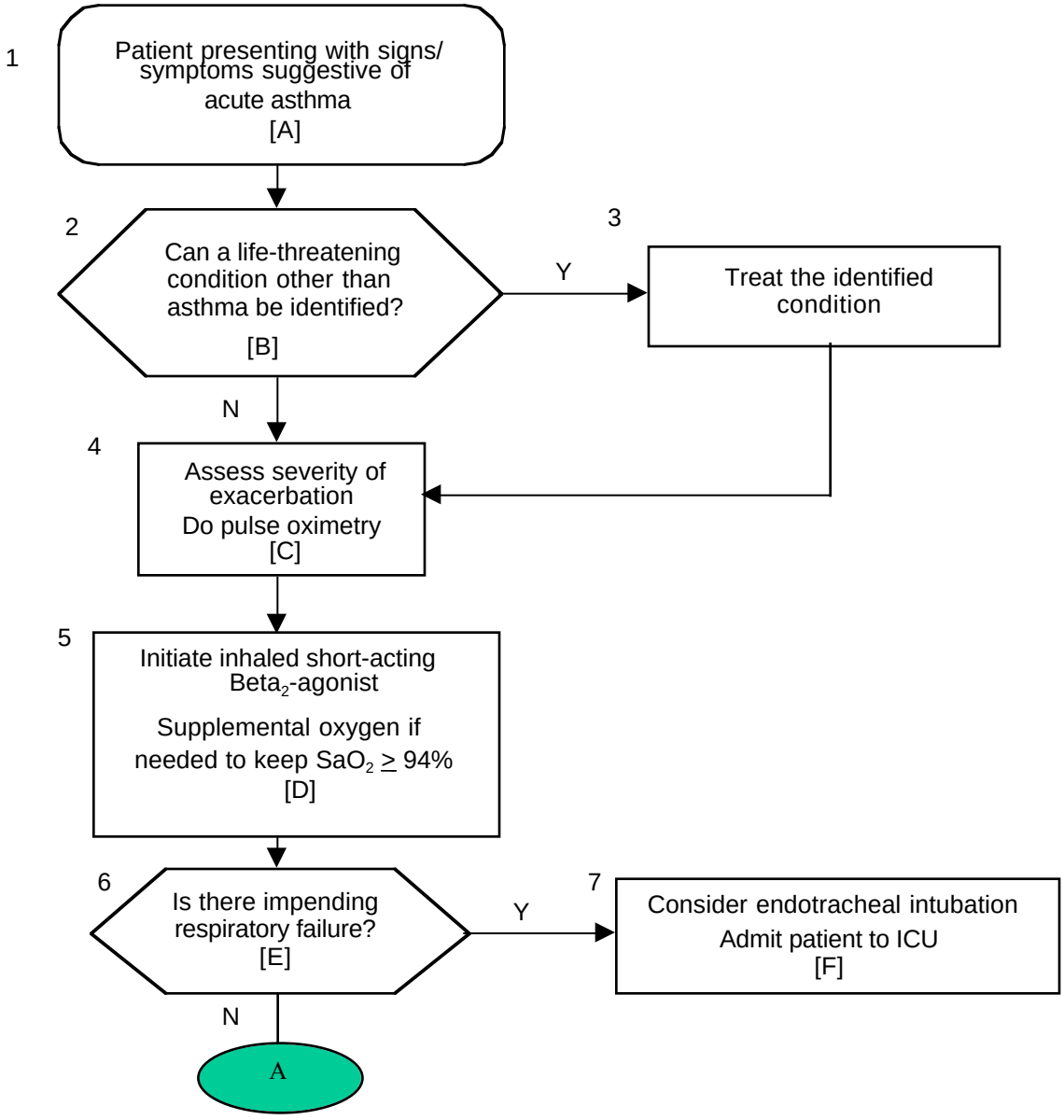
Algorithm A2p: 3 of 3

Asthma Treatment Follow-Up Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



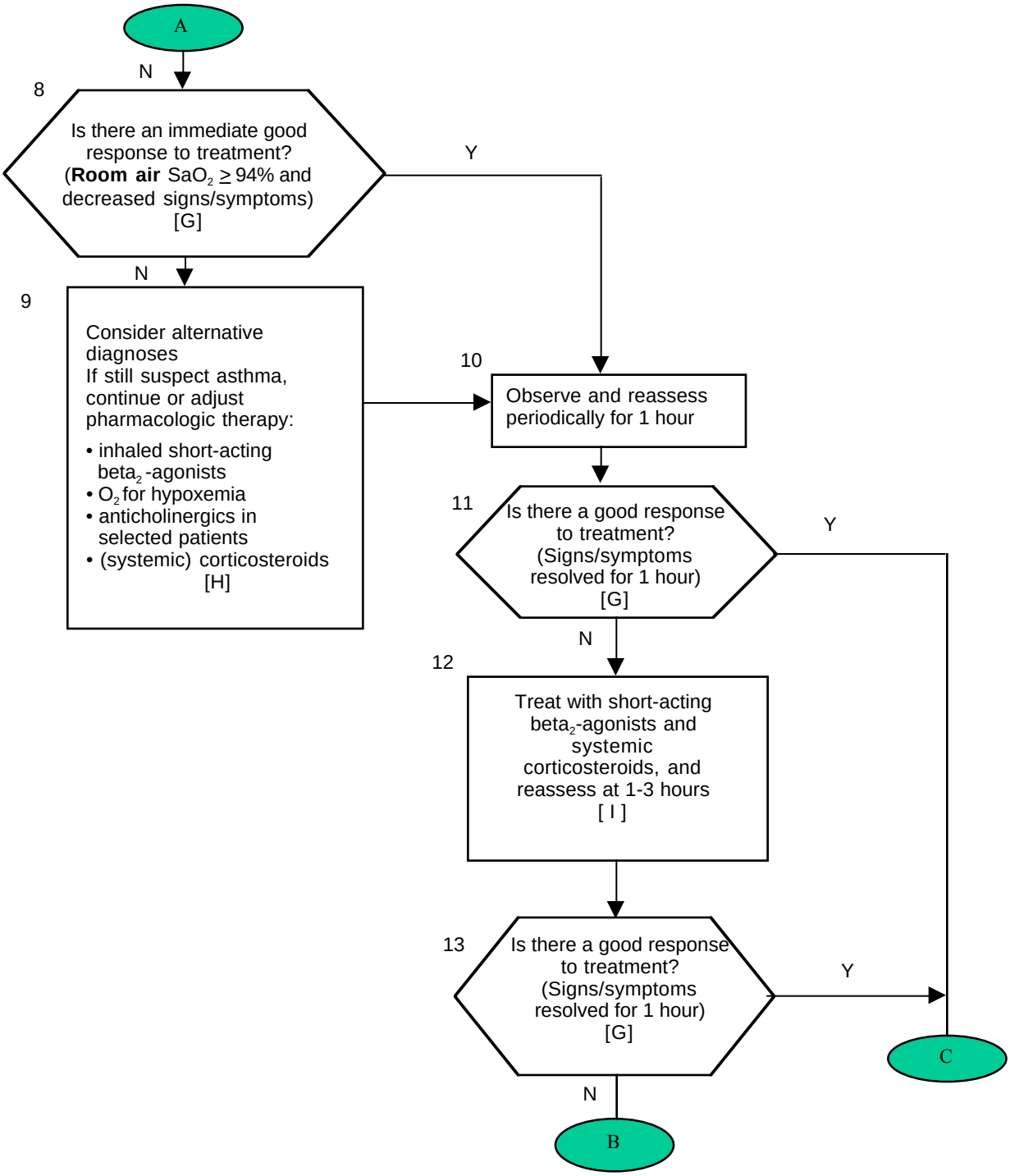
Algorithm A3p: 1 of 3

Asthma Emergency Management for Infants and Children
Under 6 Years Old Who Cannot Perform Spirometry



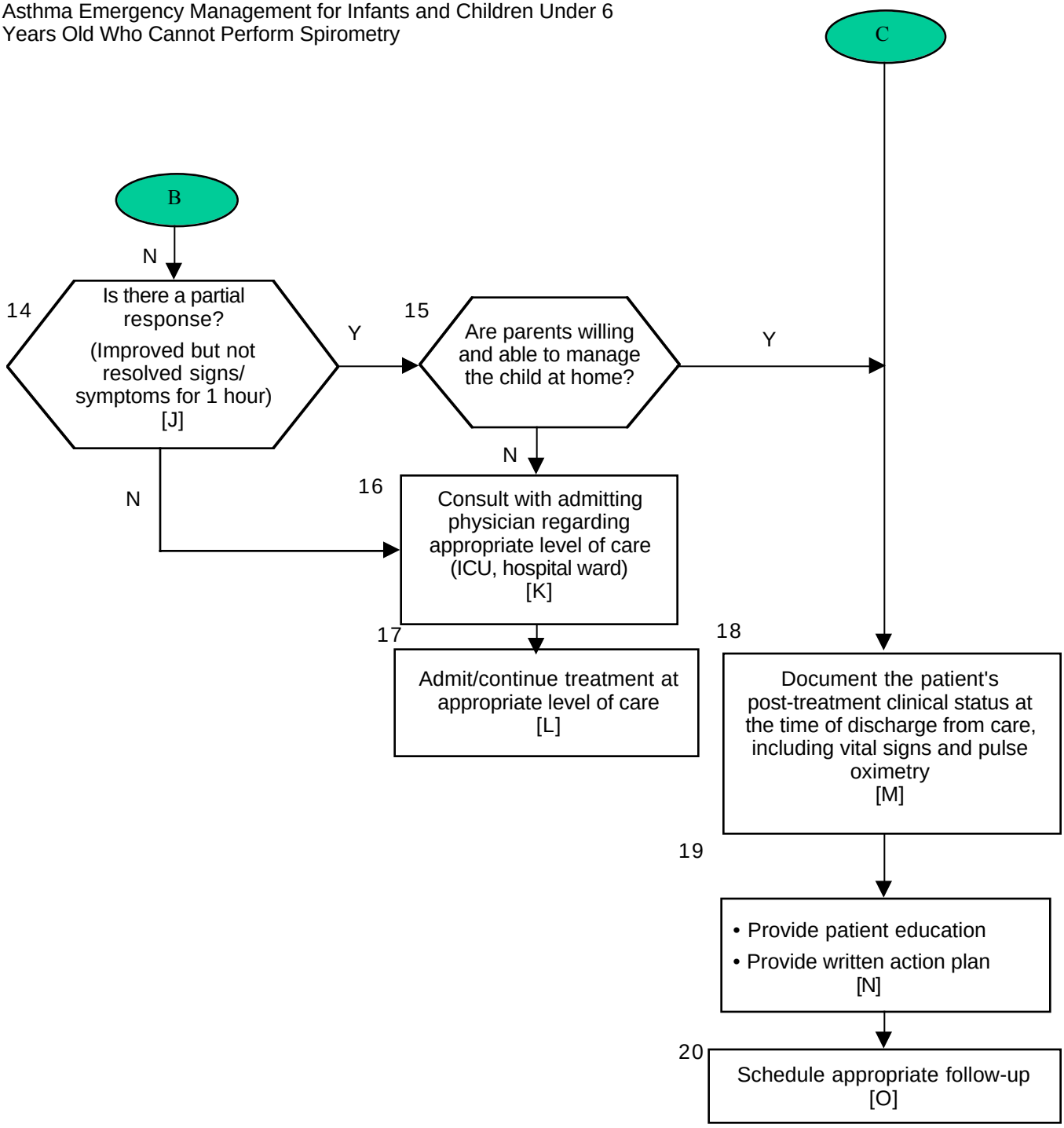
Algorithm A3p: 2 of 3

Asthma Emergency Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



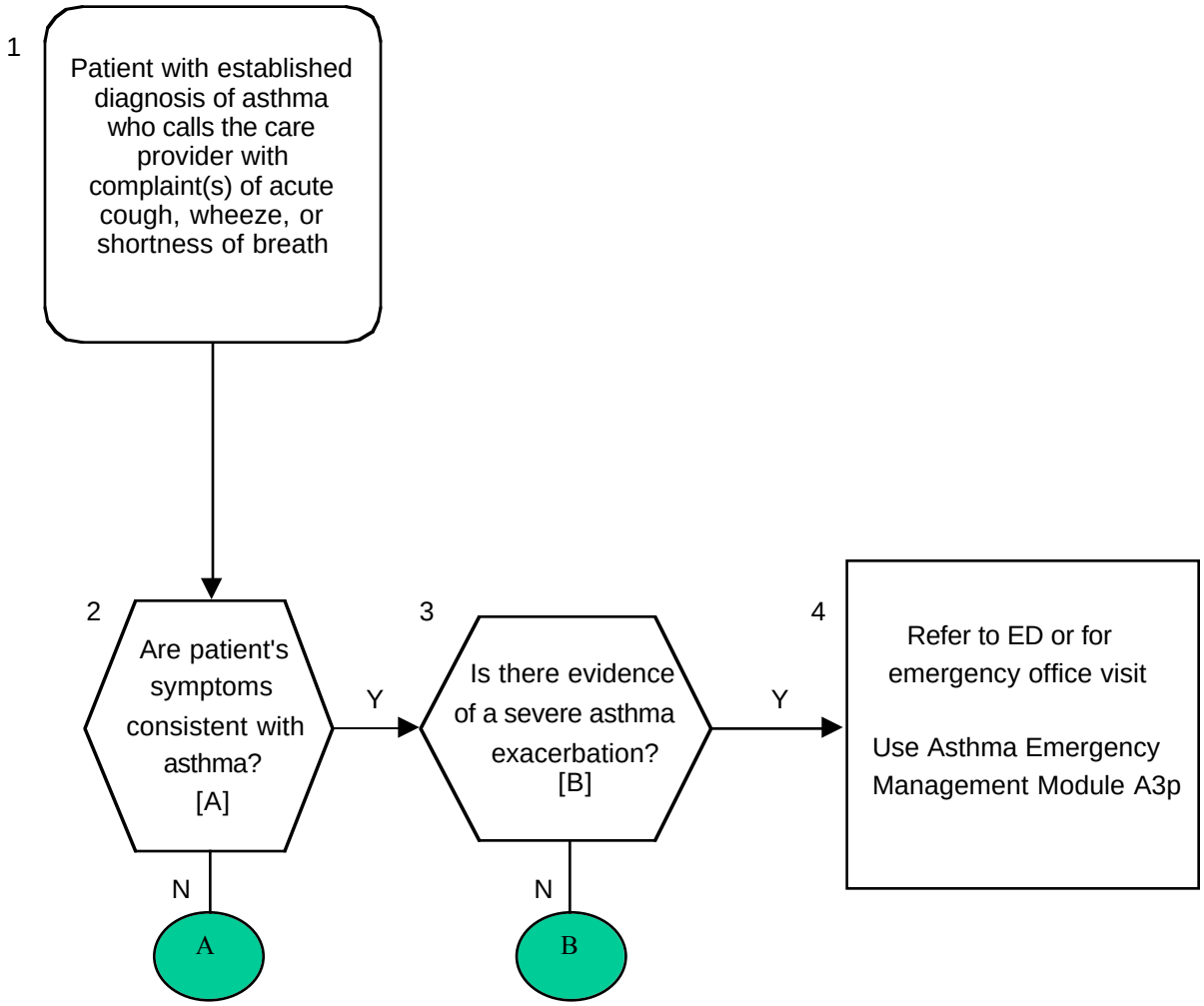
Algorithm A3p: 3 of 3

Asthma Emergency Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



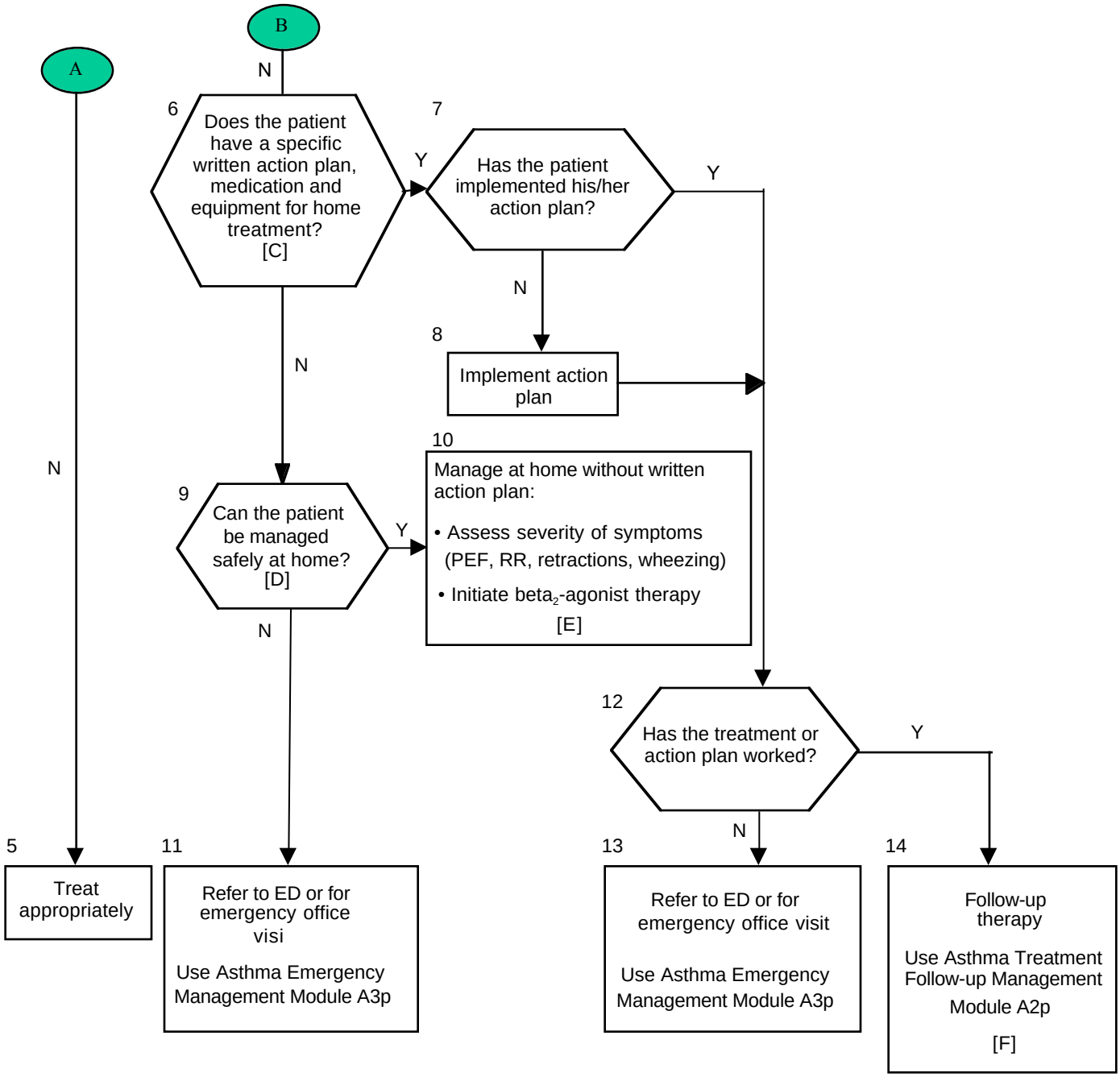
Algorithm A4p: 1 of 2

Asthma Telephone Triage Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



Algorithm A4p: 2 of 2

Asthma Telephone Triage Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry



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ANNOTATIONS

Asthma Diagnosis and Initial Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry (A1p)

(Please note that this guideline is designed for children who cannot perform spirometry. For those children under 6 years old who can perform spirometry, consider using the algorithm for Adults and Children Aged 6 years and older.)

A. (Box 1) Patient with Respiratory Symptoms (Cough/Wheeze) Presenting for Care

OBJECTIVE: To highlight common presentations of asthma for infants and children

ANNOTATION:

Consider a diagnosis of asthma in an infant or child when there exists:
- Wheezing, though the absence of wheezing does not exclude asthma
- Shortness of breath, chest tightness
- History of the following:
  - Recurrent bronchiolitis or bronchitis
  - Chronic cough, especially a persistent night time cough
  - Prolonged respiratory symptoms (greater than 10 days) with upper respiratory tract infections (URIs)
  - Recurrent pneumonia
  - Exercise intolerance

DISCUSSION:

Asthma is under-recognized in children. Consider asthma if any of the indicators listed below are present. None of these are diagnostic of asthma, but the presence of multiple indicators increases the likelihood of asthma. Asthma is defined by reversible airway obstruction, which can be either persistent or include symptom-free intervals. In young children, asthma is primarily diagnosed by the history and physical examination because most children less than 6 years old cannot perform lung function tests properly.

Indicators of asthma:
- Wheezing, although a common sign of asthma, may be absent.
- History of any of the following: cough (especially worse at night or with exertion), recurrent wheeze, difficulty in breathing, or chest tightness.
- Respiratory symptoms occur or are made worse by: exercise, viral URI, animals with fur or feathers, house dust mites, mold, smoke, pollen, changes in weather or airborne chemicals.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Common presentations of asthma for infants and young children	NAEPP EPR-2 1997	C	1
Diagnosis of infant asthma	Skoner & Caliguiri 1988 Morgan & Martinez 1992 Brugman et al. 1995	C	1

B. (Box 2) Perform History, Physical Examination and Tests, and Assess Patient

OBJECTIVE: To outline the medical history, physical examination findings, and laboratory tests that are useful in diagnosing asthma

ANNOTATION:

Important components of the medical history are exercise tolerance, cough frequency, response to respiratory infections and respiratory irritants, allergens/triggers, family history of asthma or allergy, and quantification of passive smoke exposure. Important associated conditions are rhinitis, sinusitis, eczema, and gastroesophageal reflux disorder (GERD).

Other important historical components are:
- Severity of symptoms (including nocturnal respiratory symptoms)
- Limitations in lifestyle
- Urgent-clinic and emergency department (ED) visits
- Hospitalizations, ICU admissions, endotracheal intubations
- Asthma medication use
- Environmental exposures

The physical examination for asthma focuses on:
- Vital signs
- Eyes, ears, nose and throat
- Chest
- Skin

A chest radiograph is strongly recommended for any child with suspected asthma who has not had a previous one.

Laboratory studies which are occasionally helpful include evaluation of allergy to aeroallergens with either skin prick tests or in vitro tests (RAST), complete blood count (including eosinophil count), total serum IgE, sinus CT scan to evaluate for chronic sinusitis, barium swallow (rule out vascular ring), sweat chloride test (rule out cystic fibrosis), pH probe (rule out GERD), and TB skin test.

The primary trigger in children < 4 years old is URIs; allergy plays a less important role in children < 4 years old than it does in older children and adults.

The diagnosis of asthma is based on the patient's medical history, physical examination, and other laboratory test results. In younger children, because they cannot usually perform spirometry, the diagnosis of asthma is based primarily on history and physical examination.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Useful history and physical exam findings for diagnosing asthma	NAEPP EPR-2 1997	C	1
Clinical evaluation of asthma	Li & O'Connell 1996	C	1
Allergies play a less important role in children < 4 years old	Wilson et al. 1992 Duff et al. 1993	B	2a
Rhinosinusitis; association with asthma	Wald 1995 Friday 1988	C	1

C. (Box 3) Are There Signs and/or Symptoms of Acute Asthma?

OBJECTIVE: To recognize the signs and symptoms of acute asthma

ANNOTATION:

The quickest way to assess asthma severity is to evaluate respiratory signs/symptoms and patient comfort level.
- Usual signs/symptoms of acute asthma are shortness of breath, chest tightness, cough and wheezing
- Other symptoms are anxiety and dyspnea

- Signs/symptoms may start acutely or progress over hours to days
- Other signs of acute asthma are tachypnea, tachycardia, accessory respiratory muscle use, prolonged expiratory phase, hyperinflation of chest, inability to speak in full sentences, cyanosis, and confusion or lethargy

DISCUSSION:

The degree of wheezing may not correlate with the severity of asthma. Decreased wheezing may actually indicate worsening asthma and impending respiratory failure.

Triggers of asthma exacerbations include: URIs, allergen exposure, exercise, toxic fume inhalation, tobacco smoke, and breathing cold air.

Patients with a history of previous hospitalizations (especially ICU admissions), previous need for mechanical ventilation for asthma, recent ED visits, and long-term oral corticosteroid use are at risk for more severe or unresponsive asthma exacerbations that may result in hospitalization.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Clinical assessment of acute asthma in children	Kerem et al. 1990 Kerem et al. 1991 Geelhoed et al. 1990 Schuh et al. 1997	B	1
Risk factors for fatal asthma	Strunk 1989	B	1

D. (Boxes 5 and 14) Can a Diagnosis Other than Asthma Be Identified?

OBJECTIVE: To identify alternative diagnoses to asthma that require treatment

Please note that the presence of an alternative diagnosis does not preclude the need for continued evaluation for asthma.

ANNOTATION:

Differential diagnosis of asthma in infants and children < 6 years old:
- Cystic fibrosis
- Allergic rhinitis
- Sinusitis
- Foreign body in the trachea or bronchus
- Vascular rings
- Laryngotracheomalacia, subglottic stenosis, or bronchial stenosis
- Tracheoesophageal fistula (type H) and laryngo-tracheal-esophageal cleft
- Bronchopulmonary dysplasia
- Chronic aspiration (either anterograde or from GERD)
- Psychogenic cough

DISCUSSION:

Recurrent episodes of cough and wheezing are usually due to asthma, in both children and adults. Under-diagnosis of asthma is a frequent problem, especially in those children who primarily wheeze only with URIs. These children are often labeled as having bronchitis, bronchiolitis, or pneumonia even though the signs/symptoms are most compatible with a diagnosis of asthma.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Differential diagnosis of asthma in infants and children	NAEPP EPR-2 1997	C	1
Diagnosis of infant asthma	Brugman et al. 1995 Hillman 1994 Morgan & Martinez 1992 Skoner & Caliguiri	C	2a

E. (Box 7) Clinical Suspicion of Asthma is High?

OBJECTIVE: To define "high clinical suspicion of asthma," and to alert the clinician to prescribe a trial of asthma medication (a therapeutic trial)

ANNOTATION:

Suspect asthma if any of the following are present:
- Documentation in the patient's clinical chart of wheezing and treatment with bronchodilators on more than one occasion
- Wheezing noted at the time of the exam. However, the absence of wheezing does not rule out asthma
- History of recurrent cough, especially nighttime cough, recurrent wheezing, or exercise intolerance with chest tightness/cough
- History of respiratory symptoms worsening with exercise, URIs, exposure to aeroallergens, weather changes, or smoke
- Frequent colds with a lingering (> 2 weeks) cough which tends to worsen at night
- Chest tightness, wheeze, or cough which worsens at night
- A history of recurrent pneumonia/bronchitis

Supporting evidence for asthma includes a family history of asthma, eczema, allergic rhinitis.

If the clinical suspicion for asthma is high then proceed to a therapeutic trial.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Common clinical findings in children with asthma	NAEPP EPR-2 1997	C	1

F. (Box 8) Prescribe a Trial of Asthma Therapy

OBJECTIVE: To define an appropriate trial of asthma therapy

ANNOTATION:

- For infants and children who have intermittent signs/symptoms of asthma:
  - Administer a beta$_2$-agonist up to every 4 hours when the patient is symptomatic. Beta$_2$-agonists delivered via MDI/holding chamber or nebulizer are preferred, but can consider PO albuterol syrup
  - Re-examine patients when they are symptomatic

- For symptomatic patients who do not respond to beta$_2$-agonists or those who improve with bronchodilators but fail to completely clear their signs/symptoms, consider a short course of PO corticosteroids (approximately 2 mg/kg/day of prednisone for 5-7 days)

For infants and children who present with persistent signs/symptoms of asthma:

- In addition to prescribing a beta$_2$-agonist consider one of the following:
  - A 5-7 day course of PO corticosteroids, usually prednisone (2mg/kg/day)
  - A 4-6 week trial of a controller asthma medication
    - Low-moderate dose inhaled corticosteroids administered with a holding chamber
    - Cromolyn administered by nebulizer or holding chamber (nebulizer preferred)

Please note that it is very important to follow up the patient after starting any trial of asthma medications. The patients/parents should be instructed to observe closely for improvement of asthma signs/symptoms. Each patient should be reevaluated within 1 - 4 weeks of the therapeutic trial. Patients should also be re-evaluated when they are symptomatic, as they may have signs of asthma at those times which could help confirm the diagnosis.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Oral and parenteral corticosteroids are useful in treating acute asthma exacerbations in children	Brunette et al. 1988 Tal et al. 1990 Weinberger 1988 Younger et al. 1987	B	1
Albuterol delivered by MDI with spacer or nebulizer are equivalent in patients capable of cooperating	Amirav and Newhouse 1997 Lee et al. 1991 Parkin et al. 1995 Chou et al. 1995 Williams et al. 1996 Kerem et al. 1993	B	1

G. (Box 12) Intensify Asthma Therapy

OBJECTIVE: To define how to intensify asthma therapy when the initial therapeutic trial failed

ANNOTATION:

- If the patient has failed to respond to the initial therapeutic trial for asthma but asthma is still considered a possibility, then intensify the therapeutic regimen.
  - Prescribe a short course of PO corticosteroids (usually prednisone - approximately 2 mg/kg/day for 5-7 days) if this has not yet been tried
  - Increase the dose of inhaled corticosteroids to moderate doses if low doses were originally prescribed

Note: make sure that the patient does not have a comorbid factor, e.g., sinusitis, which is interfering with the success of the therapeutic trial. Emphasize to the patient and parent to observe for changes in asthma signs/symptoms. Ensure that the patient is adhering to the treatment plan.

H. (Box 16) Assess and Categorize Asthma Severity and Prescribe Medication Based on Table A (p. 53)

OBJECTIVE: To define the features sufficient to place a patient in a specific asthma severity category and prescribe appropriate asthma medication

The characteristics noted in **Table A** (p. 53) are general and may overlap because asthma is highly variable. Assign patients to the highest severity category in which they have any of the features. An individual's severity classification may change over time.

Patients at any level of severity can have mild, moderate, or severe exacerbations. Some patients with intermittent asthma may experience severe and life-threatening exacerbations separated by long periods of normal lung function and no symptoms.

Some patients with asthma should be referred to an asthma specialist for evaluation. Indications for referral include:

- Patients with severe persistent asthma - always refer
- Patients with moderate persistent asthma - consider referral
- Patients with persistent asthma should be evaluated for allergies by either skin testing or *in vitro* testing
- Patients who are unresponsive to therapy or are not meeting goals of therapy
- Patients who have had life-threatening asthma exacerbations
- Problems in differential diagnosis
- The presence of conditions complicating asthma: sinusitis, severe rhinitis, GERD
- Patients requiring additional asthma education
- Patients being considered for immunotherapy
- Patients requiring continuous oral corticosteroids or more than two corticosteroid "bursts" per year

TABLE OF EVIDENCE:

Intervention	Reference	Grade of Evidence	Strength of Recommendation
Assess asthma severity	NAEPP EPR-2 1997	C	1

I. (Box 17) Evaluate for Triggers and Recommend Environmental Controls

OBJECTIVE: To provide a plan for evaluation of triggers and control of environmental factors

ANNOTATION:

- Obtain a detailed history of triggers to include:
- Irritants and allergens
- Consider increased exposure to viral pathogens (e.g., day care)
- Allergy testing (skin prick or RAST tests)
  - Should be directed at allergens to which the patient is exposed
  - Interpretation must include clinical relevance
  - Food allergies rarely trigger asthma
  - Limited use in children < 4 years old

DISCUSSION:

A comprehensive allergy trigger history is often difficult to obtain. Factors limiting history include the time needed to answer questions, difficulty remembering past exposures, and multiple locations where exposures may have occurred. The use of tools such as a questionnaire that the patient and family can complete at home before the follow-up visit is encouraged. Examples of screening tools are provided in the NAEPP ERP-2 guidelines.

The association of asthma and allergy has long been recognized, though this association is weaker in children less than 4 years old than in older children and adults. Recent studies confirm that sensitization to indoor allergens such as house dust mite, animal dander, and cockroach or to the outdoor fungus Alternaria is a risk for developing asthma in children. Sensitization to outdoor pollens carries less risk for asthma, although grass and ragweed pollen exposures have been associated with seasonal asthma.

An allergic reaction in the airways caused by natural exposure to allergens leads to increases in airway inflammation, airway hyperresponsiveness, and pulmonary eosinophils. Research has demonstrated that asthma symptoms, pulmonary function, and need for medication in asthma patients sensitized to dust mites correlate with the level of

house dust mite exposure. Reducing house dust mite exposure decreases asthma symptoms, nonspecific bronchial hyperresponsiveness, and airway inflammation. These reports emphasize that allergen exposure must be considered in the treatment of asthma. Aeroallergens, and not food allergens, are the most important allergens in children.

Determination of sensitivity to a perennial indoor allergen usually cannot be accomplished with medical history alone. Increased symptoms during vacuuming or bed-making and decreased symptoms when away from home are suggestive but not sufficient. Skin testing, and in vitro tests, e.g. RAST, are reliable in determining the presence of specific IgE, but these tests do not determine whether the specific IgE is responsible for the patient's symptoms. Patients should only be tested for sensitivity to the allergens to which they are exposed.

Skin or in vitro tests for patients exposed to perennial allergens can be useful in older children (usually > 3 years old) to determine allergy. They are essential to justify the expense and effort involved in implementing environmental controls. In addition, patient adherence to maintaining environmental controls (e.g., with regard to pets) is likely to be poor without proof of the patient's sensitivity. Large panels of indiscriminate allergen specific IgE measurements, whether by in vitro RAST testing or in vivo skin testing, may result in unnecessary costs and/or test-related morbidity.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Tools for allergy screening	NAEPP-ERP 2 1977	C	2a
The strong association between asthma and allergy	Reid et al. 1986 Peat et al. 1993 Creticos et al. 1996	A	2a
Allergies play a less important role in children < 4 years old	Wilson et al. 1992 Duff et al. 1993	B	2a
Allergy history does not accurately predict positive allergy tests	Murray & Milner 1995	B	1
Cockroach allergy is common in inner city children with asthma	Call et al. 1992 Kang et al. 1993 Rosenstreich et al. 1997	B	1
Indoor fungi can aggravate asthma/allergies	Strachan 1988 Bjornsson et al. 1995 Smedje et al. 1996	B	2a
Dust mite allergy can aggravate asthma, and dust mite control measures may help reduce dust mite exposure	Platts-Mills & Chapman 1987 Ehnert et al. 1992 Wickman et al. 1994 Peat et al. 1996 Marks et al. 1994 Frederick et al. 1997	B	2a
RAST and skin tests can reliably predict the presence of allergen specific IgE	Adinoff et al. 1990	B	1
RAST vs. skin testing	Adinson, Jr. 1980 Van der Zee et al. 1988 Matsson et al. 1998	B	2a
Rationale for allergy testing for perennial indoor allergens	Nelson 1995 Ingram et al. 1995	B	1

J. (Box 18) Provide Patient Education and Written Action Plans

OBJECTIVE: To emphasize the importance of asthma education and written Action Plans

ANNOTATION:

Patient education is essential for the successful management of asthma. Patient education should begin at and then continue from the first visit.

Critical education elements include:
- Proper demonstration of MDI and holding chamber (with or without face mask) technique. Review this at each clinic visit.
- A written Asthma Action Plan should be provided to the family
- Teaching the basic pathophysiology of asthma
- Discussion of medications (therapeutic mechanism, indications and adverse effects)
- Early recognition and prompt treatment of asthma exacerbations
- Avoidance or control of important triggers

The Asthma Action Plan should include:
- Medications and environmental management
- Acute episode management
- Chronic management
- School/day care Action Plans
- Asthma monitoring strategies

DISCUSSION:

Essential components of the written Action Plan include current medications and dosages, warning signs/symptoms of asthma exacerbations, instructions for use of asthma medications during exacerbations, and instructions (including telephone numbers) for when and whom to call.

For patients with persistent asthma, diaries which include symptoms, medications used, and outcomes may be useful.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines on written Action Plans	NAEPP EPR-2 1997	C	2a
Written asthma plans can decrease asthma morbidity	Cote 1997 Lieu 1997	B	2a

K. (Box 19) Schedule Follow-Up Visit

OBJECTIVE: To provide recommendations for follow-up evaluation of patients both while the diagnosis of asthma is being considered and after the initial diagnosis is made

ANNOTATION:

General recommendations:
- Maximize continuity of care in the evaluation process preferentially with the patient's primary care provider (PCM)
- Consider weekly or bimonthly visits until asthma or an alternative cause has been diagnosed
- Patient's severity should ultimately dictate frequency of follow-up
- Follow-up after initial diagnosis should be within 2 - 4 weeks

DISCUSSION:

It is recognized that the steps of this algorithm and/or the diagnosis of asthma may not be completed in a single office visit. Additionally, the optimal time course for establishing the diagnosis or following up with a newly diagnosed asthmatic has not been determined.

It is recommended that every effort be made to expedite the evaluation and diagnosis so that appropriate treatment may begin. After the initial diagnosis is made, several visits may be required to ensure appropriate education and medical compliance.

Asthma Treatment Follow-Up Management for Infants and Children Under 6 Years Old Who Cannot Spirometry (A2p)

A. (Box 2) Is There Evidence of an Acute Asthma Exacerbation?

OBJECTIVE: To recognize signs and symptoms of an acute asthma exacerbation

ANNOTATION:

The quickest way to assess asthma severity is to evaluate respiratory status and patient comfort level.

- Common signs/symptoms of acute asthma are shortness of breath, chest tightness, cough, and wheezing.
- Other symptoms are anxiety, inability to lie down comfortably or sleep due to dyspnea.
- Signs/symptoms may start abruptly or be progressive over hours to days.
- Signs of acute, severe asthma are tachypnea, tachycardia, pulsus paradoxus, accessory respiratory muscle use, prolonged expiratory phase, hyperinflation of chest, appearance of anxiety, inability to speak in full sentences (age-dependent), cyanosis, and confusion or lethargy.
- The prominence of wheezing may not correlate with the severity of the asthma exacerbation. Decreased wheezing may actually indicate worsening asthma and impending respiratory failure.
- Triggers of asthma exacerbations: upper respiratory infections (URIs), allergen exposure, exercise, toxic fume inhalation, tobacco smoke, and breathing cold or dry air.
- A history of previous frequent hospitalizations (especially to an ICU), previous need for mechanical ventilation for asthma, recent emergency department (ED) visits, and a history of prolonged, severe asthma are all risk factors for severe asthma exacerbations which may result in hospitalization.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Clinical assessment of asthma in children	Kerem et al. 1990 Kerem et al. 1991 Geelhoed et al. 1990 Schuh et al. 1997	B	1
Risk factors for potentially fatal asthma	Strunk 1989	B	1

B. (Box 4) Perform Interim History and Physical Exam

OBJECTIVE: To highlight the important aspects of the interim history and physical examination

A good interim history should include the following:

- Signs/symptoms of asthma
- Hospitalizations (ICU/intubations) and emergency department (ED) visits
- Missed school days
- Triggers
- Identification of the characteristics of the patient's typical exacerbation
- Comorbidities
- Aggravating factors
- URIs
- Aeroallergens
- Exercise
- Irritants (tobacco smoke, perfume)
- Medication adherence
- Medication adverse effects

A focused physical examination should concentrate on the following areas:

- Upper respiratory tract, specifically the ears, nose, throat, and neck
- Chest
- All patients receiving oral corticosteroids should have blood pressure checks at every asthma clinic visit
- Linear height should be recorded at least twice a year for all patients
- All children receiving long-term inhaled or systemic corticosteroids should have heights measured with a stadiometer and plotted on a standard growth curve at each asthma clinic visit

DISCUSSION:

The purpose of periodic assessment and ongoing monitoring is to assure that the goals of asthma therapy are being achieved. Ongoing monitoring in the five areas listed below is encouraged.

1. Every patient with asthma (age-dependent) and care provider should be taught to recognize symptoms that indicate inadequate asthma control. Symptoms and clinical signs of asthma should be assessed at each healthcare visit.
2. It is crucial to determine how asthma is affecting the patient's quality of life. A variety of comprehensive survey instruments have been developed (e.g., Juniper Scale) to assess functional status.
3. Monitoring of exacerbations is important. Ask about precipitating exposures, unscheduled clinic visits for asthma or calls for advice concerning asthma.
4. Pharmacotherapy assessment includes addressing adherence, inhaler and spacer/holding chamber technique, changes in medication dosage, use of rescue medications, and adverse effects. It is also critical that the clinician ensure that the patient is on the correct "step of pharmacotherapy" and has both an up-to-date written daily self-management plan and Action Plan.
5. Healthcare providers need to regularly assess the effectiveness of patient-provider communication. Unrestricted communication between the clinician, patient, and family is essential to ensure successful self-management. Easy telephone access is important.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Important features of the history and physical exam	NAEPP ERP-2 1997	C	1

C. (Box 5) Assess and Classify Asthma Severity Using Table A (p. 53)

OBJECTIVE: To define the features sufficient to place a patient in an asthma severity category

ANNOTATION:

Assign patients to the highest asthma severity category in which they have any of the features. The characteristics noted in **Table A** (p. 53) are general and may overlap because asthma is highly variable. An individual's severity classification may change over time.

Patients at any level of severity can have mild, moderate, or severe exacerbation. Some patients with intermittent asthma may experience severe and life-threatening exacerbations separated by long periods of normal lung function and no symptoms. Many toddlers do well in between URI-induced asthma exacerbations.

TABLE OF EVIDENCE

Intervention	References	Grade of Evidence	Strength of Recommendation
Asthma severity classification	NAEPP EPR-2 1997	C	1

D. (Box 6) Are There Comorbid Conditions Affecting Asthma Control?

OBJECTIVE: To identify medical conditions that can aggravate asthma

ANNOTATION:

Comorbid conditions which can aggravate asthma:
- Sinusitis
- Gastroesophageal reflux (GERD)
- Allergic rhinitis
- Tracheomalacia

DISCUSSION:

GERD may be difficult to diagnose. Silent GERD can result in lower airway inflammation or may exacerbate pre-existing airway inflammation. Subtle symptoms of GERD include unexplained irritability, foul smelling breath, cough worse with sleep and in the recumbent position, and difficult-to-control asthma.

Undertreated allergic rhinitis and/or sinusitis can exacerbate asthma. Consider these two diagnoses in any child with asthma who has persistent upper respiratory tract symptoms.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
GERD; association with asthma	Orenstein 1991 Eid et al. 1994 Orenstein 1988	**C**	1
Rhinosinusitis; association with asthma	Wald 1995 Friday 1988	C	1

E. (Box 8) Are There Medication Adverse Effects?

OBJECTIVE: To identify common adverse effects of medications

ANNOTATION: **ADVERSE EFFECTS OF DRUGS TABLE**

Drug	Adverse Effects
Corticosteroids A. Inhaled: • Beclomethasone • Budesonide • Flunisolide • Fluticasone propionate • Triamcinolone acetonide	Cough, dysphonia, oral thrush (candidiasis). In high doses (see figure 3-5b of NAEPP EPR 1997), systemic effects may occur
B. Systemic: • Methylprednisolone • Prednisolone • Prednisone	Short-term use: – Hyperglycemia – Increased appetite – Personality changes – Fluid retention – Weight gain – Hypertension – Peptic Ulcer Disease – Aseptic necrosis of the femoral head Long-term use: – Adrenal axis suppression – Growth suppression – Dermal thinning – Hypertension – Diabetes mellitus – Cushing's syndrome – Cataracts – Muscle weakness – Impaired immune function
Cromolyn and Nedocromil	– Cough – Unpleasant taste – Bronchospasm – Lactose intolerance – Nasal congestion – Nausea – Irritation of throat
Methylxanthines • Theophylline	– Insomnia – Gastrointestinal upset – Hyperglycemia – Hypokalemia – Aggravation of GERD – Overdose: tachycardia, nausea & vomiting, tachyarrhythmias, central nervous stimulation, headache, seizures
Short acting Beta$_2$-Agonists – Albuterol – Bitolterol – Pirbuterol – Metaproterenol	– Headache – Tachycardia – Skeletal muscle tremor – Hypokalemia – Hyperglycemia
Anticholinergics-Inhaled – Ipratropium	– Dry mouth – Blurred vision if introduced into eyes
Epinepherine	– Convulsions – Chills – Fever – Hallucinations – Cardiovascular stimulation – Skeletal muscle tremor

DISCUSSION:

Inhaled corticosteroids and their effect on growth in children The effects of inhaled corticosteroids on both growth rate and final height in children are not completely known. Some studies found that moderate doses of inhaled corticosteroids did suppress growth (Doull et al. 1995) , while other studies noted that moderate doses of inhaled steroids did not (Allen et al. 1998; Merkus 1993). In addition, Konig et al., noted that 800 mcg of budesonide taken for at least six months did not reduce bone mineralization or decrease bone resorption in children with asthma. In a thorough review of the literature, Efthimiou and Barnes concluded that the long-term use of inhaled beclomethasone at doses up to 400 mcg/day had no significant effect on bones or growth in the large majority of patients with asthma (Efthimiou and Barnes 1998). Therefore, while inhaled corticosteroids may cause growth suppression, low-moderate doses are unlikely to significantly effect growth in children.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendations
Adverse effects of asthma medications	NAEPP EPR-2 1997 Horowitz 1998	C	1
Inhaled corticosteroids and growth	Merkus et al. 1993 Konig et al. 1993 Doull et al. 1995 Allen et al. 1998 Efthimiou et al. 1998	C	1

F. (Box 10) Are There Problems With Patient Adherence/Inhaler Technique?

OBJECTIVE: To assure that medication is taken as prescribed using proper technique

ANNOTATION:

- MDIs are most effective when used in conjunction with a spacer/holding chamber. Children < 4 years old may do better with a holding chamber equipped with a face mask
- Reassess both proper MDI and spacer/holding chamber technique at every visit
- If using a nebulizer, review proper technique at every visit

DISCUSSION:

After establishing that the patient/care provider understands the care plan, the next key question is: is the patient following it? *Understanding does not equate to adherence*. Patients may be unwilling to admit that they have not been following prescribed treatment. Determine which elements of the care plan, if any, are not being followed. Ask the patient and care provider why they are not following it. Elements to reconsider when there is nonadherence include: language comprehension, reading skills, visual or hearing problems, medical and psychosocial factors, and comprehension or retention of information.

Activities and questions that help to determine the level of patient adherence include: reviewing the symptom diary, medication use, and prescription refill patterns. In addition, it is important to identify the parts of the treatment plan that are most difficult to perform and the changes which might make it easier to carry out. Identify the parts of the treatment plan that work best.

TABLE: MEDICATION MANAGEMENT PLAN

ASSESSMENT QUESTIONS	INFORMATION	EXPECTED SKILLS AND KNOWLEDGE	REFERRALS
Do you understand why you are prescribed these medicines?	The written medication management plan identifies the name for each ordered medication (generic and trade).	The patient identifies each medication used and states the action for each drug.	Asthma educator to supplement or provide teaching elements
What does each drug do?	Action of drug and its importance		
What is the dose and frequency for each drug?	Dose and frequency	Identifies dose and frequency for each drug.	
What are the undesirable adverse effects with each of these drugs?	Potential adverse effects, possible interactions What to do if there is an adverse effect	Describes possible adverse effects for each drug. Knows who to call or what to do when there is an adverse effect.	
Which drug is your controller and which is your reliever? Why should you only take relievers when you have worsening of difficult breathing?	1. **Controller or Preventer** medicines – anti-inflammatory agents and steroids: Effects not immediately apparent but are the most important in treating the underlying inflammation of the airway in asthma. 2. **Relievers** – Drugs which relieve symptoms (bronchodilators)	Differentiates controller from reliever. Differentiates fast reliever from slow reliever and knows the importance of using each as directed.	
Why do you only take your salmeterol twice daily?	Differentiate fast relievers (fast onset, short acting) (e.g., albuterol) from slow relievers (slow onset, long acting) (e.g., salmeterol).	States that salmeterol does not take effect for a few hours but lasts a long time.	

G. (Box 12) Environmental Triggers Identified

OBJECTIVE: To identify important environmental triggers

ANNOTATION:

The following are important environmental triggers:
- Aeroallergens
  - Dust mites
  - Animal dander
  - Pollens
  - Molds
- Tobacco smoke
- Smoke from wood burning stoves
- Air pollution
- Cold air
- Weather changes

Measures to identify allergens:
1. Allergy history alone may not be sufficient to identify whether a patient has significant allergies
2. Consider skin or RAST testing for patients with mild persistent asthma who are > 4 years old
3. Skin or RAST testing is recommended for patients with moderate or severe persistent asthma who are > 4 years old

DISCUSSION:

Note: Allergies play a less important role in asthma in children < 4 years old than they do in older children.

Rationale for Allergy Testing for Perennial Indoor Allergens The determination of sensitivity to perennial indoor allergens is usually not possible with medical history alone (Murray and Milner 1995). Increased symptoms during vacuuming or bed making and decreased symptoms when away from home are suggestive but not sufficient to identify dust mite sensitive patients. Allergy skin or in vitro (RAST) tests are reliable in determining the presence of specific IgE (Adinoff et al. 1990), but these tests do not determine whether the specific IgE is responsible for the patient's symptoms.

It is recommended that all children with persistent asthma be tested for aeroallergens with either RAST or skin tests. This recommendation will result in approximately half of all children with asthma being tested. This recommendation pertains to children > 3 years old. Children younger than this often have less of an allergic component, and they should be tested on an individual basis. It is estimated that about half of all asthma patients have persistent asthma based on data on children in the United States (Taylor and Newacheck 1992) and on adults in Australia (Boston Consulting Group 1992). Approximately 80% of the U.S. population is exposed to house dust mites (Nelson and Fernandez-Caldas 1995), 60% to cat or dog, and a much smaller percentage to both animals (Ingram et al. 1995). Cockroaches are a consideration primarily in the inner city and southern parts of the United States.

Skin or in vitro tests for patients exposed to perennial allergens are essential to justify the expense and effort involved in implementing environmental controls. In addition, patient adherence to maintaining environmental controls (e.g., with regard to pets) is likely to be poor without proof of the patient's sensitivity to allergens. However, large panels of indiscriminate allergen specific IgE measurements, whether by in vitro RAST testing or in vivo skin testing, may result in unnecessary costs and/or test-related morbidity.

RAST Testing In vitro testing for individual allergen specific IgE (RAST) can be used, in conjunction with detailed environmental and trigger history, to identify allergen sensitization and the need for specific environmental controls and immunotherapy. However, RAST tests are NOT as sensitive as skin testing and have a number of pitfalls or abuses. These include the provider ordering too many allergens to be tested for or failing to select a laboratory with adequate quality control and standardization practices (resulting in potentially higher rates of false positive and false negative rates).

Advantages of Skin Testing:
- Less expensive than in vitro tests
- Results are available within one hour
- More sensitive than in vitro tests
- Results are visible to the patient which may encourage adherence to environmental control measures

Advantages of RAST and other in vitro tests:
- Do not require knowledge of skin testing technique
- Do not require availability of allergen extracts
- Can be performed on patients who are taking medications that suppress the immediate skin test (antihistamines)
- No risk of systemic reactions
- Can be done on patients with extensive eczema

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Tools for allergy screening	NAEPP-EPR 2 1997	C	2a
The strong association between asthma and allergy	Reid et al. 1986 Peat et al. 1993 Creticos et al. 1996	A	1
Allergies play a less important role in children < 4 years old	Wilson 1992 Duff 1993	B	2a
Allergy history does not accurately predict positive allergy tests	Murray 1995	B	1
RAST vs. skin testing	Adinson, Jr. 1980 Van der Zee 1988 Matsson 1998	B	2a
RAST and skin tests can reliably predict the presence of allergen specific IgE	Adinoff 1990	B	1
Prevalence of asthma in children	Taylor 1992	B	1
Frequent exposure to common aeroallergens	Nelson 1995 Ingram 1995	B	1
Weather changes and asthma	Celenza et al. 1996 Newson et al. 1998	B	2a

H. (Box 13) Develop Plan to Minimize Environmental Triggers

OBJECTIVE: To identify measures to minimize environmental exposure to triggers

ANNOTATION:

Identify allergic triggers by in vitro or in vivo diagnosis of allergens when indicated.

Use dust mite avoidance measures for dust mite allergic patients:

Primary measures
- Encase mattress in an allergen-impermeable cover
- Encase pillow in an allergen-impermeable cover or wash it weekly
- Wash sheets and blankets on the patient's bed in hot water weekly (Send sheets and blankets out or turn water temperature up to > 130 °F, the temperature necessary for killing mites. Since this is a potential burn risk in households with children, usually keep water temperature < 120^0 to protect children)

Secondary measures
- Reduce indoor humidity to less than 50 percent
- Remove carpets from the bedroom
- Avoid sleeping or lying on upholstered furniture
- In patients' bedrooms, minimize the number of stuffed toys and wash the toys weekly in hot water.

Pet avoidance: if sensitization has been documented then remove animals from house or, at a minimum, keep animals out of patient's bedroom and cover (with a filter) the air ducts that lead to the bedroom.

- Indoor mold prevention:
  - Fix all leaks and eliminate water sources associated with mold growth
  - Clean moldy surfaces
  - Consider reducing indoor humidity to less than 50 percent
- To avoid exposures to pollens (trees, grass, weeds)

  - Stay indoors with windows closed and air-conditioning/air cleaner turned on during the season that the patient is having problems with outdoor allergens, especially during the afternoon.
- Indoor/outdoor pollutants and irritants
  - Avoid wood-burning stoves or fireplaces
  - Avoid poorly vented stoves or heaters
  - Avoid other irritants (e.g., perfumes, cleaning agents, sprays)

DISCUSSION:

Environmental Control Measures:

Dust Mite Dust mite avoidance measures are noted in Annotation H, this module. Chemical agents are available for killing mites and denaturing the antigen, but they are not very effective. Therefore, use of these agents in the homes of house dust mite sensitive asthma patients is not routinely recommended. Vacuuming removes mite allergen from carpets but is inefficient at removing live mites.

Cockroach Allergen Cockroach sensitivity and exposure are common among patients with asthma who live in inner cities (Kang et al. 1993; Call et al. 1992). In an inner city asthma study, asthma severity increased with increasing levels of cockroach antigen in the bedroom of sensitized children (Rosenstreich et al. 1997). Although no studies have been published that report the effect of cockroach reduction on asthma symptoms, the NAEPP ERP-2 states that control measures should be instituted when the patient is sensitive to cockroaches and infestation is present in the home. Patients should not leave food or garbage exposed. Poison baits, boric acid, and traps are preferred to chemical agents because the latter can be irritating when inhaled by asthma patients. If chemical agents are used, the home should be well ventilated, and the patient should not return to the home until the odor has dissipated.

Indoor Fungi (Molds) Indoor fungi are particularly prominent in humid environments and homes that have dampness problems. Because some studies have found an association between indoor fungi and both respiratory and allergic disease (Bjornsson et al. 1995; Smedje et al. 1996; Strachan 1988), measures to control dampness or fungal growth in the home may be beneficial.

Outdoor Allergens (Tree, Grass, and Weed Pollens and Seasonal Mold Spores) Patients can reduce exposure by staying indoors with windows closed in an air-conditioned environment (Solomon et al. 1980), particularly during the midday and afternoon when pollen and some spore counts are highest. Conducting outdoor activities shortly after sunrise will result in less pollen exposure. These actions may not be realistic for some patients.

Tobacco Smoke Advise those in the home who smoke to stop smoking or to smoke outside the home. Discuss ways to reduce exposure to other sources of tobacco smoke, e.g., day care providers. Consider referral to smoking cessation program for affected family members.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Dust mite allergy can aggravate asthma and dust mite control measures may help reduce dust mite exposure	Plats-Mills & Chapman 1987 Ehnert et al. 1992 Wickman et al. 1994 Peat et al. 1996 Marks et al. 1994 Frederick et al. 1997	B	2a
Cockroach allergy is common in inner city children with asthma	Call et al. 1992 Kang et al. 1993 Rosenstreich et al. 1977	B	1
Indoor fungi can aggravate asthma/allergies	Strachan et al. 1998 Bjornsson et al. 1995 Smedje et al. 1996	B	2a
Reduction of outdoor allergen	Solomon et al. 1980	B	2a

Intervention	References	Grade of Evidence	Strength of Recommendation
exposure in an indoor air-conditioned environment			

I. (Box 14) Are Symptoms Controlled?

OBJECTIVE: To determine whether the patient's asthma is controlled

ANNOTATION:

Criteria for good control:
- Patients with mild intermittent asthma: normal activity level, able to sleep through the night without waking with asthma symptoms, and requiring doses of reliever medication less than twice a week.
- Patients with mild-moderate persistent asthma: normal activity level, infrequent nocturnal symptoms and exacerbations, and requiring doses of reliever medication less than twice a day.
- Patients with severe persistent asthma: near normal activity level, infrequent awakening at night, reduced need for reliever medication, reduced frequency of corticosteroid bursts, and reduced (or elimination of) ED visits and hospitalizations.

J. (Box 15) Consider Medication Step-Down

OBJECTIVE: To provide instruction on medication step-down

ANNOTATION:

- For patients whose asthma is well controlled, consider step-down therapy.
- Caution: patients should be followed closely as their symptoms may increase with medication step-down.
- For inhaled steroids, the dosage should be decreased by no more than 25% every 2-3 months.

K. (Box 16) Consider Medication Step-Up (See Table A, p. 53)

OBJECTIVE: To instruct on increasing medications when symptoms are not controlled, based on current asthma severity level and control. Also to provide instruction on when to refer to an asthma specialist

ANNOTATION:

Reclassify patient's asthma severity, reconsider the differential diagnosis, and consider a comorbid process. This might be an appropriate time for referral of the patient to the next higher level of care, such as an asthma specialist. For guidelines on pharmacologic management of asthma using the step classification system, see **Table A** (p. 53).

Indications for referral to asthma specialist (derived from the NAEPP EPR-2 1997):
- Patients with severe persistent asthma - always refer
- Patients with moderate persistent asthma - consider referral
- Patients with persistent asthma should be evaluated for allergies by either skin testing or in vitro testing (if > 3 to 4 years old)
- Patients who are unresponsive to therapy or are not meeting goals of therapy
- Patients who have had life-threatening asthma exacerbations
- Problems in differential diagnosis
- The presence of conditions complicating asthma: sinusitis, severe allergic rhinitis, GERD
- Patients requiring additional asthma education
- Patients being considered for immunotherapy
- Patients requiring continuous oral corticosteroids or more than two corticosteroid "bursts" per year

L. (Box 17) Provide and/or Review and Update Patient Education and Written Action Plans

OBJECTIVE: To ensure that every patient has up-to-date education and a written Action Plan

ANNOTATION:

Asthma Action Plan All patients should have written Asthma Action Plans.

Patient/parent education Patient/parent education is essential for successful management of asthma. Patient/parent education should continue from the first visit.

Important education elements:
- Proper demonstration of MDI and spacer/holding chamber technique (review at every visit)
- Proper nebulizer instruction (every visit)
- Review or develop a written Asthma Action Plan
- The basic pathophysiology of asthma
- Medications: mechanism of action, indications for use, and adverse effects
- Early recognition and prompt treatment of asthma exacerbations
- Avoidance or control of environmental triggers

Action Plan elements include:
- Medication management
- Environmental management
- Management of exacerbations
- Long-term management
- School/day care plan
- How the patient's asthma will be monitored

DISCUSSION:

Essential components of the written Action Plan include current medications and dosages, warning signs and symptoms of impending exacerbations, instructions for use of asthma medications during exacerbations, and instructions (including telephone numbers) for when and whom to call.

For patients with persistent asthma, diaries which include symptoms and medications used can be useful management tools.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines on written Action Plans	NAEPP, EPR-2 1997	C	2a
Written asthma plans can decrease asthma morbidity	Cote et al. 1997 Lieu et al. 1997	B	1

M. (Box 18) Preventive Health Maintenance

OBJECTIVE: To review the appropriate preventive health services for patients with asthma

ANNOTATION:

Patients should receive:
- Annual influenza vaccination for patients > 6 months old with persistent asthma
- Asthma education
- Height measurements in children on a regular basis, especially for those taking inhaled or oral corticosteroid therapy

For those patients using long-term oral corticosteroid therapy consider:
- Annual eye exams to assess for posterior sub-capsular cataracts. Patients who are only receiving inhaled corticosteroids do not require annual eye exams as their risk for cataracts is low.

- Blood pressure measurements at each asthma clinic visit

Patients taking long-term oral corticosteroid therapy should NOT receive the varicella, oral polio, or measles vaccines (live virus vaccines).

DISCUSSION:

All patients with persistent asthma who are > 6 months old should receive the influenza vaccination annually.

All patients requiring long-term oral steroid therapy should be counseled on possible adverse effects including diabetes, cataract formation, suppression of hypothalamic-pituitary adrenal axis, weight gain, and growth suppression.

Patient Education Patient education is essential for successful management of asthma. Patient education should be set up at the first visit for asthma and then continued.

Critical education elements are:
- Demonstration of appropriate spacer/holding chamber technique or nebulizer instruction
- Education concerning allergen avoidance (See Annotations G and H, this module)
- Recognition and response to exacerbations
- Medication roles and adverse effects
- The written Asthma Action Plan should be reviewed (See Annotation L, this module)

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Influenza immunization recommendations for asthmatic children	Red Book 1997	C	1
Inhaled corticosteroids and growth	Merkus et al. 1993 Konig et al. 1993 Doull et al. 1995 Allen et al. 1998 Efthimiou et al. 1998	C	1
Long-term oral corticosteroids are a risk factor for cataracts in asthmatic children	Bhagat et al. 1984	B	2a
Low risk of cataracts with inhaled corticosteroids	Abuekteish et al. 1995 Agertoft et al. 1998	B	2a
Children receiving long-term oral corticosteroid therapy should not receive live virus vaccinations	Red Book 1997	C	1
Patient education improves asthma quality of care	Clafin et al. 1996 Kolbe et al. 1996 Boulet et al. 1995	C	1

N. (Box 19) Schedule Follow-Up Visit

OBJECTIVE: To determine frequency of follow-up visits

ANNOTATION:

Recommended frequency of follow-up:

- Mild Asthma: every 6 - 12 months
- Moderate Persistent Asthma: every 3 - 6 months
- Severe Persistent Asthma: every 1 -3 months

More frequent visits may be necessary if clinically indicated.

Asthma Emergency Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry (A3p)

A. (Box 1) Patient Presenting with Signs and/or Symptoms Suggestive of Acute Asthma

OBJECTIVE: To recognize when a patient is experiencing an acute asthma exacerbation

ANNOTATION:

The quickest way to assess asthma severity is to evaluate respiratory status and patient comfort level:
- Common signs/symptoms of acute asthma are cough, wheeze, shortness of breath and chest tightness
- Other symptoms are anxiety, inability to lie down comfortably or sleep due to dyspnea
- Signs/symptoms may start abruptly or be progressive over hours to days
- Signs of acute, severe asthma are tachypnea, tachycardia, pulsus paradoxus, accessory respiratory muscle use, prolonged expiratory phase, hyperinflation of chest, appearance of anxiety, inability to speak in full sentences (age-dependent), cyanosis, and confusion or lethargy
- The prominence of wheezing may not correlate with the severity of the asthma exacerbation. Decreased wheezing may actually indicate worsening asthma and impending respiratory failure
- Triggers of asthma exacerbations include: upper respiratory infections (URIs), allergen exposure, exercise, toxic fume inhalation, tobacco smoke, and breathing cold or dry air.

A history of previous frequent hospitalizations for asthma (especially to an ICU), previous need for mechanical ventilation for asthma, recent emergency department (ED) visits, and a history of prolonged, severe asthma are all risk factors for severe asthma exacerbations which may result in hospitalization.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Clinical assessment of acute asthma in children	Karem et al. 1990 Kerem et al. 1991 Geelhoed et al. 1990 Schuh et al. 1997	B	1
Risk factors for fatal asthma	NAEPP EPR-2 1997 Strunk 1989	C	1

B. (Box 2) Can a Life-Threatening Condition Be Identified?

OBJECTIVE: To exclude life-threatening conditions that may mimic acute, severe asthma

ANNOTATION:

Evaluate for severe asthma and other pulmonary causes of airway obstruction and respiratory distress which are potentially life threatening.

DISCUSSION:

Differential diagnosis of asthma: The patient's respiratory distress may be due to a diagnosis other than asthma including:
- Foreign body in trachea or bronchus
- Epiglottitis
- Laryngotracheobronchitis (croup, bacterial tracheiitis)
- Pulmonary edema
- Pneumonia
- Pneumothorax
- Anaphylaxis or anaphylactoid reactions
- Vascular rings or laryngeal webs

- Subglottic/tracheal stenosis
- Bronchiolitis

Patients who do not have an identified alternative cause for their respiratory distress should continue to be treated for asthma. Also, those patients who have asthma in addition to other causes of respiratory distress should continue to be treated for asthma.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Differential diagnosis of acute, severe asthma	NAEPP EPR-2 1997 Chernick & Boat Eds. 1998	C	1

C. (Box 4) Assess Severity of Exacerbation and Do Pulse Oximetry

OBJECTIVE: To assess the severity of the asthma exacerbation using physical examination and pulse oximetry

ANNOTATION:

When evaluating the severity of asthma, pay attention to the physical exam and vital signs. Also, perform pulse oximetry, and consider doing an arterial blood gas measurement (ABG) if the patient is in severe respiratory distress.

- **General appearance** Observe for the patient being anxious, working hard to breathe, and unable to speak. These are all signs of a severe asthma exacerbation
- **Vital signs** Very severe asthma exacerbations are usually associated with a respiratory rate of > 40/minute in young children and > 60/min in infants
- **Wheezing** Wheezing correlates poorly with the degree of airflow limitation
- **ABG** Patients who are in severe respiratory distress should have their ventilatory status assessed by measuring arterial PCO_2 with an ABG
- **Chest retractions** The presence of chest retractions suggests severe airway obstruction
- Peak flow rate and forced expired volume in the first second (FEV_1) are not reliable measurements in most children < 6 years old

DISCUSSION:

Physical exam (See **Assessment Of Asthma Severity Table** immediately below) and clinical scoring systems may be useful for identifying patients in severe respiratory distress caused by asthma. High scores (meaning more severe clinical findings) correlate well with severe airway obstruction. However, low scores (less severe clinical findings) do not necessarily signify less severe obstruction. Thus, a patient who appears relatively comfortable by physical exam may still have severe airway obstruction. The presence of chest retractions is the physical sign that correlates best with severe airway obstruction. A room air pulse oximetry reading obtained after treatment with bronchodilators of < 94% is a risk factor for requiring hospitalization.

Wheezing is a useful sign to help one make a diagnosis of asthma, but it does not correlate well with the degree of airway obstruction. Patients with severe airway obstruction may not wheeze because they may not have sufficient airflow to produce wheezing. The degree of wheezing is not a good predictor of which children will require hospital admission.

Pulse oximetry measures oxygenation but not ventilatory function. When a patient is in severe respiratory distress due to an asthma exacerbation and is not responding well to therapy, it is important to consider obtaining an ABG to determine the patient's arterial PCO_2. Some patients suffer respiratory arrest at high levels of $PaCO_2$ and others at relatively normal levels of $PaCO_2$. However, a $PaCO_2$ in the normal range (38-42 mm Hg) in a patient who is in respiratory distress from asthma indicates significant airway obstruction. A $PaCO_2$ > 42 mm Hg with signs of respiratory distress is an indicator of very severe acute asthma, and patients with $PaCO_2$ > 42 mm Hg should be admitted to an intensive care unit.

TABLE: ASSESSMENT OF ASTHMA SEVERITY

Signs	Mild	Moderate	Severe	Respiratory Arrest Imminent
Respiratory rate	Increased	Increased	Often > 30/minute	Often > 40/min (> 60 in infants)
Accessory muscle use (retractions)	Usually not	Commonly	Usually	Paradoxical thoraco-abdominal movement
Wheeze	Moderate; often only end expiratory	Loud throughout exhalation	Usually loud, both inspiratory and expiratory	Absence of wheeze
$PaCO_2$ (breathing room air) if obtained	< 40 mm Hg (test not necessary)	<40 mm Hg (test usually not necessary)	$\geq$ 42 mm Hg possible respiratory failure	$\geq$ 42 mm Hg progressing to respiratory failure
Room air % SaO_2 (at sea level)	95% (test not usually necessary)	91 to 95%	< 91%	< 91%

Risk factors for life-threatening exacerbations of asthma include a history of severe asthma, poorly controlled asthma, family psychosocial dysfunction, failure by the patient or patient's physician to recognize severity of asthma, nonadherence to medical therapy, and daily use of corticosteroids. A history of previous hospitalization for asthma and especially a history of requiring intubation with mechanical ventilation for asthma increase the likelihood that the patient will require in-hospital care.

Laboratory tests may be useful in both managing severe asthma and diagnosing comorbid diseases. Consider CBC with differential, electrolytes, phosphate, magnesium, ionized calcium, ABG, and chest radiograph.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Classifying the severity of asthma exacerbations	NAEPP EPR-2 1977	C	1
Clinical scoring systems for asthma	Becker et al. 1984 Kerem et al. 1990	B	2a
Pitfalls in clinical scoring systems for acute asthma	Baker 1988	B	2a
Use of pulse oximetry to predict need for hospitalization and assessing asthma severity	Kerem et al. 1990 Geelhoed et al. 1990 Kerem et al. 1991 Schuh et al. 1997	B	2a
Clinical physiologic correlates in asthma	McFadden et al. 1973 McFadden 1986	B	1
Wheezing and severity of airway obstruction	Shim and Williams 1983	B	2a
Clinical exam and hypoxemia do not predict the ventilatory defect in acute severe asthma: argument for obtaining $PaCO_2$	Rees et al. 1967	B	2a
Risk factors for fatal asthma	NAEPP EPR-2 1997 Strunk 1989	C	1
Potentially useful laboratory tests	NAEPP EPR-2 1997	C	1

D. (Box 5) Initiate Inhaled Short-Acting Beta$_2$-Agonists and Oxygen Therapy to Keep $SaO_2 \geq 94\%$

OBJECTIVE: To quickly initiate bronchodilator treatment, and to use supplemental oxygen when necessary

ANNOTATION:

Administration of inhaled short acting beta$_2$-agonists and oxygen will often produce rapid improvement and prevent clinical complications. Try to keep $SaO_2 \geq 94\%$; this can usually be accomplished with 1-2 liters of supplemental oxygen delivered by nasal cannula.

DISCUSSION:

Administer inhaled beta$_2$-agonists either by MDI with holding chamber or nebulizer. Administration of 4-8 puffs of albuterol by MDI with holding chamber every 20 minutes up to a total of 24 puffs in one hour is as effective as nebulizer treatments provided the patient is able to coordinate the inhalation maneuver (See Annotation H, this module, for both **Dosages** and **Table of Evidence**).

E. (Box 6) Is There Impending Respiratory Failure?

OBJECTIVE: To identify patients at risk for respiratory arrest

ANNOTATION:

Prompt recognition of the signs of respiratory failure is critical for initiation of appropriate treatment that may prevent cardiopulmonary arrest and death.

Suspect impending respiratory failure if any of the following are present:
- Altered level of consciousness (severe agitation, confusion, obtundation, or coma)
- Cyanosis or refractory hypoxemia ($PaO_2 < 60$ mm Hg or $SaO_2 < 90\%$ while the patient is breathing room air at sea level)
- $PaCO_2 \geq 42$ mm Hg in a patient experiencing respiratory distress
- Paradoxical thoracoabdominal movement
- Silent chest on auscultation (absence or cessation of wheeze)
- Bradycardia
- Evidence of exhaustion

DISCUSSION:

The majority of asthma deaths are preventable provided the severity of the exacerbation is recognized and appropriate treatment is promptly started. Respiratory acidosis due to respiratory muscle fatigue, hypotension, or poor oxygenation contributes to an increased risk for cardiopulmonary arrest.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Indicators of respiratory failure	NAEPP EPR-2 1997	C	1

F. (Box 7) Consider Endotracheal Intubation. Admit to ICU

OBJECTIVE: To outline the initial steps for stabilization of a patient with severe asthma and impending respiratory failure

ANNOTATION:

Initial strategies for stabilization may include:
- Begin or continue supplemental oxygen, and try to achieve 100% FiO_2

- Continuous pulse oximetry monitoring
- Inhaled short acting beta$_2$-agonists administered either hourly or continuously
- The addition of an anticholinergic agent (ipratropium) for selected patients
- Obtain intravenous access, correct hypovolemia if present, but avoid over-hydration
- Administer parenteral corticosteroids (for doses, see Annotation H, this module)
- Consider subcutaneous epinephrine or terbutaline

Patients in respiratory failure or who are in cardiorespiratory arrest should be intubated.

Sedation with propofol, narcotics and/or benzodiazepines by a provider experienced in their use. Neuromuscular blockade may be considered in some patients.

General guidelines for mechanical ventilation:
- Aim for adequate gas exchange with lowest possible peak inspiratory pressure (PIP)
- Low tidal volumes (5 to 8 ml/kg) and low ventilator rates (approximately 10/min)
- Adjust inspiratory flow rate, respiratory rate and I:E ratio (prolong expiration) to allow adequate ventilation, minimize PIP, and to allow plenty of time for exhalation
- Use permissive hypercapnia to avoid barotrauma associated with high PIP
- Keep arterial pH > 7.1; $PaCO_2$ < 100 mm Hg; PIP < 50 cm H_2O (< 30 cm H_2O optimal)
- Sedate for optimal patient-ventilator interaction
- Titrate oxygen to maintain oxygen saturation > 90% (> 94% is optimal). Elevate head of bed to greater than 30 degrees
- Utilize neuromuscular blockade only by providers experienced in their use

Perform laboratory and other diagnostic studies as indicated. Consider CBC, electrolytes, ABG, chest radiograph, and EKG.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Mechanical ventilation in patients with severe asthma	Dworkin and Kattan 1989 Cox et al. 1991	B	2a
Permissive hypercapnia is safe and reduces peak inspiratory pressures	Hickling 1994 Tuxen 1992 Dworkin and Kattan 1989 Cox et al. 1991 Dries 1995	B	2a

G. (Box 8, 11 and 13) Is There a Good Response to Treatment?

OBJECTIVE: To define a 'good response' to treatment and identify those patients who have improved enough to be discharged to home

ANNOTATION:

A good response to therapy includes the following criteria, and a patient should meet these criteria before being discharged home:
- No respiratory distress
- Physical exam is at patient's baseline
- Room air $SaO_2 \geq 94\%$

DISCUSSION:

Many patients respond transiently to initial treatment. If the symptomatic response is sustained for at least one hour, then reassess the patient's signs/symptoms and pulse oximetry. If these have adequately improved, then the patient can

be safely discharged to home after arranging appropriate follow-up and providing adequate instructions and asthma education.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Assessing response to therapy	NAEPP, EPR-2 1997	C	2a

H. (Box 9) Consider Alternative Diagnoses to Asthma. Continue or Adjust Pharmacologic Therapy

OBJECTIVE: To determine what to do when there has not been a good response to initial therapy

ANNOTATION:

Consider alternative diagnoses in those patients who fail to respond to asthma therapy. Adjust supplemental oxygen and pharmacologic therapy to the patient's clinical situation, and consider diagnoses other than asthma.

Adjust pharmacologic therapy:

- Continue inhaled short-acting $beta_2$-agonists
- Treat hypoxemia, defined as $SaO_2 < 90\%$ or $PaO_2 < 60$ mm Hg while breathing room air. Use supplemental oxygen to keep $SaO_2 > 90\%$ and preferably $\geq 94\%$.
- Note the dosages of drugs for asthma exacerbations in emergency medical care or hospitalized patients in the **Hospital Checklist for Inpatients with Asthma Exacerbations Table** in Annotation L of Module A3p.

DISCUSSION:

The usual medical treatment regimen is to continue the frequent multiple daily dosing of bronchodilators until the patient has clinically improved, which is usually within 48 hours. Oral corticosteroid therapy following a hospitalization or emergency department visit is usually continued for an additional 3-10 days. There is no need to taper PO corticosteroids when they are given for < two weeks. If systemic corticosteroids are to be given more than once daily, one study indicates it may be more clinically effective to give the dose in the afternoon.

TABLE: MEDICATION DOSES (ADAPTED FROM THE NAEPP EPR-2 1997)

Medications	Children's Dose	Comments
Inhaled short-acting beta$_2$-agonists **Albuterol**: MDI (90 mcg/puff) with spacer/holding chamber	4 to 8 puffs every 20 minutes x 3 doses then 1-4 hours as necessary	As effective as nebulized therapy if patient is able to coordinate inhalation maneuver
Nebulizer solution: (5 mg/ml)	0.15 mg/kg (maximum dose 2.5-5.0 mg) every 20 minutes x 3 doses, then 0.15-0.3 mg/kg up to 10 mg every 1-4 hours when necessary or up to 0.5 mg/kg/hr continuously by nebulizer	Only selective beta$_2$-agonists are recommended. For optimal delivery, dilute aerosols to minimum of 4 ml at gas flow of 6 to 8 L/minute
Systemic (subcutaneous) beta-agonists **Epinephrine**: 1:1000 (1mg/ml)	0.01 mg/kg up to 0.3-0.5 mg every 30 minutes x 3 doses subcutaneously	No proven advantage of systemic therapy over aerosol. May be hazardous in patients with coronary artery disease.
Terbutaline (1mg/ml)	0.01 mg/kg SQ every 20 min.x 3, q 2-6 hr prn	
Anticholinergics **Ipratropium bromide**: MDI (18 mcg/puff)	4-8 puffs as necessary	Dose delivered from MDI is low and has not been studied in asthma exacerbations.
Nebulizer solution: (0.25 mg/ml; 0.5 mg/vial)	0.25-0.5 mg every 20 minutes x 3 doses then every 2-6 hours	May mix in same nebulizer with albuterol. Should not be used as first line therapy; may be added to beta$_2$-agonist therapy.
Corticosteroids **Prednisone** **Methylprednisolone** **Prednisolone**	1 mg/kg every 6 hours x 48 hours, then 1-2 mg/kg/day with maximum of 60 mg/day For outpatient "burst" 2 mg/kg/day Maximum 60 mg/day x 3-10 days	For outpatient 'burst,' use 20-60 mg/day (approximately 2mg/kg/day) in single or two divided doses for 3-10 days (See Discussion)

TABLE OF EVIDENCE

DOSAGE AND ROUTE OF BRONCHODILATORS

Intervention	References	Grade of Evidence	Strength of Recommendation
Ipratropium (anticholinergic) therapy for acute, severe asthma in children NOTE: all studies were performed in emergency departments	Reisman et al. 1988 Schuh et al. 1995 Qureshi et al. 1997 Ducharme and Davis 1997 Qureshi et al. 1998 Zorc et al. 1999	A	1
Albuterol by MDI with spacer or nebulizer is equivalent in patients capable of cooperating	Amirav and Newhouse 1997 Parkin et al. 1995 Williams et al. 1996	A	1
Intermittent and continuously administered beta$_2$-agonists are safe and effective	Becker et al. 1983 Robertson et al. 1985 Schuch et al. 1989 Schuh et al. 1990 Katz et al. 1993 Salmeron et al. 1994	A	1

TABLE OF EVIDENCE

DOSAGE AND ROUTE OF CORTICOSTEROID THERAPY

Intervention	References	Grade of Evidence	Strength of Recommendation
Oral and parenteral administration has the same results provided normal absorption	Ratto et al. 1988 Jonsson et al. 1988 Hoffman 1988	B	1
Oral and parenteral corticosteroids are useful in treating acute asthma in children	Younger et al. 1987 Brunette et al. 1988 Tal et al. 1990 Weinberger 1988	B	1
Use of corticosteroids in the ED	Littenberg and Gluck 1986	C	2a
Timing of corticosteroid dose; afternoon doses are more effective	Beam et al. 1992 Pincus et al. 1995	B	2a

I. (Box 12) Treat with Short-Acting Beta$_2$-Agonists and Systemic Corticosteroids; Reassess at 1-3 Hours

OBJECTIVE: To specify continued treatment for patients who have not had a good response to initial therapy

ANNOTATION:

Patients who fail to have a good response to therapy require continued management and observation.

Treatment should include:
- Inhaled short-acting beta$_2$-agonists approximately every 60 minutes
- Systemic corticosteroids
- Continued treatment for another 1-3 hours

TABLE OF EVIDENCE

Intervention	References	Grade of Evidence	Strength of Recommendation
Recommendations for continued treatment of an asthma exacerbation	NAEPP EPR-2 1997	C	1

J. (Box 14) Is There a Partial Response?

OBJECTIVE: To identify patients who have had an incomplete response to asthma therapy but have had enough improvement sustained for at least one hour to consider discharging them to home with appropriate follow-up

ANNOTATION:

In a partial response, mild-to-moderate symptoms persist, but the patient has had significant clinical improvement and is in no respiratory distress.

The decision to send a patient in this group home should be individualized and depends, in part, on the parent/patient's understanding of the Action Plan and their access to care.

K. (Box 16) Consult with Admitting Physician Regarding Appropriate Level Bed (ICU, Hospital Ward)

OBJECTIVE: To identify patients with a poor response to treatment who will require continued management in an ICU or other inpatient setting

ANNOTATION:

In a poor response, there is minimal improvement in signs/symptoms with therapy. Patients with a poor response usually require admission to an ICU or other appropriate inpatient area.

If the patient has any of the following, consider admission to an ICU:
- Severe breathlessness
- Chest retractions and tachypnea
- Drowsiness and/or confusion
- $PaCO_2 > 42$ mm Hg
- Hypoxemia

L. (Box 17) Admit/Continue at Appropriate Level of Care

OBJECTIVE: To outline the general guidelines for inpatient management outside of the ICU setting

ANNOTATION:

For patients admitted to the ICU (See Annotation F, this module).

The following general guidelines are not intended to provide a detailed plan for inpatient management. In addition to treating the acute asthma exacerbation, hospital admissions should be seen as opportunities for providing additional patient education and establishing a written Action Plan.

For hospitalized patients in a non-ICU setting:
- Administer inhaled $beta_2$-agonist by MDI 4-8 puffs with spacer/holding chamber or by nebulizer (see Annotation H, this module, for dosages) every 1-4 hours
- Consider adding an inhaled anticholinergic (ipratropium) for patients not improving with $beta_2$-agonists
- Administer systemic (oral or intravenous) corticosteroids

- Administer supplemental oxygen

Continue to monitor oxygen saturation and perform physical examinations.

DISCUSSION:

TABLE: HOSPITAL CHECKLIST FOR INPATIENTS WITH ASTHMA EXACERBATIONS

Intervention	Dose/Timing	Education/Advice
Inhaled medications (MDI) + holding chamber $Beta_2$-agonists Corticosteroids	Select agent, dose, and frequency (e.g., albuterol, 2 to 6 puffs every 3 to 4 hours PRN; inhaled corticosteroids)	Teach purpose Teach technique Emphasize need for spacer/holding chamber Check patient technique
Oral medications	Select agent, dose and frequency (e.g., prednisone 20 mg bid for 3-10 days	Teach purpose Teach side effects
Follow-up visit	Make appointment for follow-up care with primary clinician or asthma specialist within 7 days of discharge	Advise patient (as appropriate) and caregiver of date, time and location of appointment
Written Action Plan	Before and again at discharge	Instruct patient (as appropriate) and caregiver on simple plan for actions to be taken for symptoms, signs, and PEF values suggesting recurrent airflow obstruction

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Inpatient management of non-ICU asthma	NAEPP EPR-2 1997	C	1

M. (Box 18) Document the Patient's Post-Treatment Status at the Time of Discharge from Care, Including Vital Signs and Pulse Oximetry

OBJECTIVE: To emphasize the documentation of discharge status

ANNOTATION:

Document the patient's condition at the time of hospital discharge:
- Record the patient's respiratory effort and use of accessory muscles on the discharge summary
- Objective measurements which should be documented include:
  - Pulse
  - Respiratory rate
  - Blood pressure
  - Pulse oximetry (while breathing room air)
  - Pulmonary function/peak flow if able to perform (rare in children < 6 years old)

N. (Box 19) Provide Patient Education and Provide Written Action Plan

OBJECTIVE: To prepare the patient/parent for self-management of asthma

ANNOTATION:

Disease management education:
- Reinforce written self-management Action Plan
- Arrange for follow-up
- Review medication use
- Continue treatment with inhaled $beta_2$-agonists
- Continue course of oral corticosteroids
- Initiate inhaled corticosteroids, when indicated, with spacer/holding chamber technique at doses appropriate for the asthma severity level (see Annotation K, Module A2p)

O. (Box 20) Schedule Appropriate Follow-Up

The timing and type of follow-up depends on the severity of the asthma exacerbation. Patients should follow up within one week with a primary care manager (PCM) or asthma specialist. Patients who required an ICU admission should be referred to an asthma specialist for consultation within 1-2 months. All asthmatics should have a PCM or be referred to get a PCM.

Asthma Telephone Triage Management for Infants and Children Under 6 Years Old Who Cannot Perform Spirometry (A4p)

A. (Box 2) Are Patient's Symptoms Consistent with Asthma?

OBJECTIVE: To determine whether the patient's respiratory symptoms are due to asthma

ANNOTATION:

Please note that this telephone management guideline should only be used for patients who have been previously diagnosed with asthma.

The quickest way to determine whether the patient's respiratory complaints are caused by asthma is to inquire about the patient's respiratory signs/symptoms.

- The usual symptoms of acute asthma are shortness of breath, chest tightness, and cough
- Symptoms may start acutely or progress over hours to days
- Signs of acute asthma which may be useful when attempting to determine the respiratory status of the patient include: degree of accessory respiratory muscle use, respiratory rate, wheezing, anxiety level, and the ability to speak in full sentences (age-dependent)
- Note: the prominence of wheezing does not correlate with the severity of the asthma exacerbation. The absence of wheezing may actually indicate worsening asthma and impending respiratory failure. In addition, wheezing is difficult to assess over the telephone

Triggers of asthma exacerbations include: URIs, allergen exposure, exercise, toxic fume inhalation, tobacco smoke, and breathing cold or dry air.

A history of previous frequent hospitalizations, previous need for intubation, recent emergency department (ED) visits, and a history of acute severe asthma are all risk factors for difficult to control or less responsive asthma attacks. Use caution when attempting to manage these patients in their home.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Clinical assessment of asthma in children	Kerem et al. 1990 Kerem et al. 1991 Geelhoed et al. 1990 Schuh et al. 1997	B	1
Signs/symptoms of acute asthma	NAEPP EPR-2 1997 Strunk 1989	C	1

B. (Box 3) Is There Evidence of a Severe Asthma Exacerbation?

OBJECTIVE: To define a severe asthma exacerbation

ANNOTATION:

In young children the severity of asthma exacerbations is primarily based upon respiratory signs/symptoms as many children less than 6 years old cannot adequately perform peak flow measurements (PEF). Patients suffering from severe exacerbations of asthma should not be managed at home.

The following suggest a severe exacerbation:

- Shortness of breath, especially at rest
- Chest retractions
- Requiring $beta_2$-agonist therapy more frequently than every two hours
- Rapid respiratory rate (see **Table** below, this annotation)

Question the patient/parent concerning the signs/symptoms noted in the following **Table**:

TABLE: ASSESSMENT OF ASTHMA SEVERITY IN CHILDREN UNABLE TO PERFORM PEAK FLOWS

Sign or symptom	Severity of Asthma exacerbation		
	mild	**moderate**	**severe**
Respiratory rate Children Infants	 < 30/min < 40/min	 30-40/min 40-60/min	 > 40/min > 60/min
Accessory muscle use (chest retractions)	*not present*	*may be present*	*usually present*
Shortness of breath	*not present*	*may be present*	*usually present*

DISCUSSION:

Please note that patients suffering from severe exacerbations of asthma should not be managed at home; they should be instructed to seek immediate medical attention (see Box 4 of the A4p algorithm).

Patients with a history of severe asthma exacerbations requiring hospitalization or ED visits are more likely to be suffering from acute, severe asthma. Use caution when attempting to manage such patients at home.

The assessment of airflow limitation using both objective measures, whenever possible, and signs/symptoms of asthma are essential to guide asthma therapy. Relying on the patient or caregiver to provide this information to the clinician by phone adds potential uncertainty. Since the prompt relief of airway obstruction is the primary goal of acute asthma management, the systematic assessment of a patient should include, when possible, measurements which can be used to determine the degree of airflow obstruction, e.g. PEF. However, many young children cannot perform peak flows reliably. Therefore, the signs/symptoms which correlate best with severe airway obstruction (shortness of breath, tachypnea, and chest retractions) should be used.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Signs/symptoms of severe asthma exacerbations	NAEPP ERP-2 1977	C	1
Risk factors for fatal asthma	Strunk 1989	B	1
Clinical assessment of asthma in children	Kerem et al. 1990 Kerem et al. 1991 Geelhoed et al. 1990 Schuh et al. 1997	A	1

C. (Box 6) Does the Patient Have A Specific Written Action Plan, Medication and Equipment for Home Treatment?

OBJECTIVE: To determine whether the patient has both an appropriate written Action Plan and proper medication and equipment to enable asthma care to continue at home

ANNOTATION:

The patient's written Action Plan should include:
- Warning signs of acute asthma
- Means to determine asthma severity
- Medication management
- Acute episode management

- Chronic asthma management
- School/day care (children) management
- Signs/symptoms of worsening asthma

Patients must have an adequate supply of $beta_2$-agonists, either MDI, dry powder inhaler, or nebulizer. They must also have ready access to oral corticosteroids.

DISCUSSION:

Action Plans for children less than 6 years old must rely on symptoms, rather than peak flow readings, as children in this age group often cannot produce peak flows reliably. The patient/parent should be able to find and follow the written Action Plan. Review the written Action Plan instructions with the care provider.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Symptom and PEF-based Action Plans are equivalent in reducing asthma flares	NAEPP, EPR-2 1997 Grampian 1994 Charlton et al. 1994 Malo 1993 Turner 1998	C	2a

D. (Box 9) Can the Patient be Managed Safely at Home?

OBJECTIVE: To highlight criteria for safe home management

ANNOTATION:

Many patients without Action Plans can still be managed at home.

The criteria for safe home management are:
- The caregiver/patient must be knowledgeable, competent, and able to follow instructions
- There must be an adequate supply of appropriate medication at home
- The patient/caregiver must be able to adequately describe the patient's signs/symptoms
- The patient must have ready access EMS services or other means to quickly obtain urgent care should the asthma attack become severe
- There should be no language or other communication difficulties which could interfere with carrying out instructions
- The patient does not have a severe asthma exacerbation

Patients who do not meet all of the above criteria should seek medical attention and should not be managed at home.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Criteria for managing patients at home	NAEPP ERP-2 1997	C	1

E. (Box 10). Manage at Home Without Written Action Plan: Assess Severity of Symptoms, Initiate $Beta_2$-Agonist Therapy, and Recommend Further Care as Appropriate

OBJECTIVE: To outline the home treatment for patients who do not have an Action Plan but still meet criteria (Annotation D, Box 9, this module) for being able to be safely managed at home

ANNOTATION:

The management of a patient who does not have a written Action Plan consists of the following:
- Assessing the severity of the asthma exacerbation (see **Assessment Of Asthma Severity In Children Unable To Perform Peak Flows Table** in Annotation B, this module)
- Instructing on the use of inhaled $beta_2$-agonists (see drug dose Table below, this annotation)
- Considering the use of PO corticosteroids (see drug dose Table below, this annotation)
- Discussing the warning signs of worsening asthma
- Instructing on when and how to seek medical attention
- Determining the appropriate methods of reevaluation and follow-up

DISCUSSION:

As peak flow measurements are difficult to obtain in young children, asthma signs/symptoms are important in determining the severity of the asthma exacerbation. The management strategy will be dictated by the severity of the exacerbation. Assessment of asthma severity should include assessing the following: shortness of breath, tachypnea, chest retractions, wheezing, frequency of $beta_2$-agonist treatments within the past 24 hours, and response to therapy. Improvement with $beta_2$-agonist therapy is reassuring but does not mean that the exacerbation is resolving. Many patients will require a short course of PO corticosteroids, e.g. prednisone, approximately 2 mg/kg/day for 3-7 days, to clear the exacerbation. Drug doses are listed in the following table:

TABLE: MEDICATION DOSES FOR CHILDREN (ADAPTED FROM THE NAEPP EPR-2 1997)

Medications	Dose	Comments
Inhaled short-acting $beta_2$-agonist Albuterol: MDI (90 mcg/puff) with spacer/holding chamber Nebulizer solution (5 mg/ml)	 4-8 puffs every 20 minutes x 3 doses and then 1-4 hours as necessary 0.15 mg/kg (up to 5 mg) every 3-4 hours	 As effective as nebulized therapy if patient is able to coordinate the inhalation maneuver
Corticosteroids: Prednisone Methylprednisolone (Medrol)	Approximately 2 mg/kg/day (maximum of 40 mg) as either a single daily dose or divided bid for 3-7 days	

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Oral corticosteroids are useful in treating acute asthma in young children	Brunette et al. 1988 Weinberger 1988	B	1
Albuterol delivered by MDI/holding chamber and nebulizer are equivalent	Kerem et al. 1993 Chou et al. 1995 Williams et al. 1996 Amirav and Newhouse 1997	A	1

F. (Box 14) Follow-up Therapy

OBJECTIVE: To outline appropriate follow-up

ANNOTATION:

The timing and type of follow-up depend on the severity of the asthma exacerbation. Most patients should be followed up with a telephone call within 24 hours. Then repeat patient contact either in person or by telephone 5-7 days later. All patients with asthma should have a primary care manager (PCM) and, ideally, follow-up should be arranged with the PCM.

Stepcare Approach for Prescribing Asthma Medications Based on Severity
Annotations for Table A-Peds: For Infants and Children
Under 6 Years Old Who Cannot Perform Spirometry

(Please note that Table A-Adults Annotations A-a through H-a apply to Table A references in Algorithms A1a and A2a, while Table A-Peds Annotations A-p through H-p apply to Table A references in A1p and A2p. Table A is located in the Appendix.)

A-p. Table A-Peds: Mild Intermittent Asthma Severity Level

OBJECTIVE: To define the signs/symptoms of mild intermittent asthma

ANNOTATION:
The patient with intermittent asthma is asymptomatic between exacerbations. Exacerbations are brief in duration, lasting a few hours to a few days, and may vary in intensity. Nighttime symptoms occur ≤ 2 times per month and daytime symptoms ≤ 2 times a week.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
Step classification system	NAEPP, EPR-2 1997	C	2a

B-p. Table A-Peds: Mild Intermittent Asthma (Step 1) Drug Therapy

OBJECTIVE: To define the therapy for mild intermittent asthma

ANNOTATION:

Long-term control: daily medication is not needed. For quick relief: a short-acting bronchodilator (e.g., inhaled $beta_2$-agonists) as needed for symptoms. The intensity of treatment will depend on the severity of the exacerbation. The use of short-acting inhaled $beta_2$-agonists more than twice a week may indicate the need to initiate long-term control therapy.

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines for treatment of mild, intermittent asthma	NAEPP, EPR-2 1997	C	2a
Short-acting $beta_2$-agonists are effective treatment for mild, intermittent asthma	Drazen et al. 1996	A	2a

C-p. Table A-Peds: Mild Persistent Asthma Severity Level

OBJECTIVE: To define the signs/symptoms of mild persistent asthma

ANNOTATION:

Exacerbations may be severe enough to affect activity. Nighttime symptoms > 2 times a month or daytime symptoms > 2 times a week but < daily.

See Annotation A-p, above, for **Table of Evidence**.

D-p. Table A-Peds: Mild Persistent Asthma (Step 2) Drug Therapy

OBJECTIVE: To define the therapy for mild persistent asthma

ANNOTATION:

Long-term control: consider low-dose inhaled corticosteroids, cromolyn, or nedocromil. For quick relief, use short-acting bronchodilators (e.g., inhaled short-acting beta$_2$-agonist) as needed for symptoms. The intensity of treatment will depend on the severity of the exacerbation. Daily use or increasing use of a short-acting inhaled beta$_2$-agonist indicates the need for intensifying long-term controller therapy.

TABLE: ESTIMATED COMPARATIVE DAILY DOSAGES FOR INHALED CORTICOSTEROIDS

Drug	Low-Dose	Medium- Dose	High-Dose
Beclomethasone dipropionate 42 mcg/puff 84 mcg/puff	84-336 mcg 2 to 8 puffs 1 to 4 puffs	336-672 mcg 8 to 16 puffs 4-8 puffs	> 672 mcg > 16 puffs > 8 puffs
Budesonide Turbuhaler 1 inhalation	100-200 mcg 1 inhalation	200 to 400 mcg 1 to 2 inhalations	> 400 mcg > 2 inhalations
Flunisolide 250 mcg/puff	500-750 mcg 2 to 3 puffs	750-1250 mcg 4 to 5 puffs	1250 mcg > 5 puffs
Fluticasone MDI: 44, 110, or 220 mcg/puff DPI: (dried powder inhaler): 50, 100, 250 mcg/puff	88-176 mcg	176-440 mcg	>440 mcg
Triamcinolone acetonide 100 mcg/puff	400-800 mcg 4 to 8 puffs	800-1200 mcg 8 to 12 puffs	1200 mcg > 12 puffs

TABLE OF EVIDENCE:

Intervention	References	Grade of Evidence	Strength of Recommendation
General guidelines for treatment of mild persistent asthma	NAEPP, EPR-2 1977	C	2a
Inhaled corticosteroids for the treatment of persistent asthma	Kerrebijn et al. 1987 Varsano et al. 1990 Barnes 1993 Hoekstra et al. 1996 Verberne et al. 1997 Simons et al. 1997 Jonasson et al. 1998	A	1
Cromolyn sodium and nedocromil	Hambleton et al. 1977 Newth et al. 1982 Konig et al. 1995	A	1
Theophylline	Weinberger et al. 1996	C	2a

Intervention	References	Grade of Evidence	Strength of Recommendation
Regular use of beta$_2$-agonists is no better than PRN use and may result in poorer asthma control	Sears et al. 1990 Van Schayck et al. 1992 Drazen et al. 1996 Gauvreau et al. 1997	A	2a

E-p. Table A-Peds: Moderate Persistent Asthma Severity Level

OBJECTIVE: To define the signs/symptoms of moderate persistent asthma

ANNOTATION:

Daily use of inhaled short-acting beta$_2$-agonist. Exacerbations affect activity. Daily exacerbations ≥ two times/week and may last for days. Nighttime symptoms > 1 time/week.

(See Annotation A-p, above, for **Table of Evidence**)

F-p. Table A-Peds: Moderate Persistent Asthma (Step 3) Drug Therapy

OBJECTIVE: To define the therapy for moderate persistent asthma

ANNOTATION:

Long-term control: daily medication should be an anti-inflammatory preferably medium-dose inhaled corticosteroid (See Annotation D-p for doses of inhaled corticosteroid). The addition of theophylline to inhaled steroids can increase control, but theophylline should only be prescribed by a physician knowledgeable in its use.

For quick relief: short-acting bronchodilator (inhaled beta$_2$-agonist) as needed for symptoms. The intensity of treatment will depend on the severity of the exacerbation. The daily or increasing use of short-acting inhaled beta$_2$-agonists suggests poor asthma control and indicates the need for intensifying long-term controller therapy.

TABLE OF EVIDENCE: (Also see **Table of Evidence** for Annotation D-p, above)

Intervention	References	Grade of Evidence	Strength of Recommendation
Adding theophylline to corticosteroids in children	Nassif et al. 1981	A	1
Addition of long-acting beta$_2$-agonist to inhaled corticosteroids is effective	NAEPP EPR-2 1997 Weinstein 1998 Blake 1999	A	1

G-p. Table A-Peds: Severe Persistent Asthma Severity Level

OBJECTIVE: To define the signs/symptoms of severe persistent asthma

ANNOTATION:

Patients with severe persistent asthma have limited physical activity, frequent exacerbations, and frequent nighttime symptoms.

(See Annotation A-p, above, for **Table of Evidence**)

H-p. Table A-Peds: Severe Persistent Asthma (Step 4) Drug Therapy

OBJECTIVE: To define the therapy for severe persistent asthma

ANNOTATION:

Long-term control (daily medications): anti-inflammatory medication should be high-dose inhaled corticosteroids. Theophylline can be added, but it should only be prescribed by physicians knowledgeable in its use. Daily PO corticosteroids (1-2 mg/kg/day or every other day) may be required; they should be titrated to the lowest daily or alternating daily dose which still controls symptoms.

For quick relief: short-acting bronchodilators (inhaled short acting $beta_2$-agonist) as needed for symptoms. The intensity of treatment will depend on the severity of the exacerbation. Daily or increasing use of short-acting inhaled $beta_2$-agonists suggests poor control and indicates the need for additional long-term control therapy. See Emergency Management of Asthma, Module A3p.

TABLE OF EVIDENCE:

See **Tables of Evidence** for Annotations D-p and F-p, above

DOD/VHA CLINICAL PRACTICE GUIDELINE
FOR THE MANAGEMENT OF

ASTHMA
FOR INFANTS AND CHILDREN UNDER 6 YEARS OLD WHO CANNOT PERFORM SPIROMETRY

APPENDIX A

TABLE A: Stepcare Approach for Prescribing Asthma Medications Based on Severity

TABLE A: Stepcare Approach for Prescribing Asthma Medications Based on Severity

Table A

Severity Level	Signs/ Symptoms	Nocturnal Symptoms	Lung Function*	Drug Therapy
Mild Intermittent [A-p]	• Symptoms ≤ 2 times/week • Exacerbations brief • Asymptomatic/normal PEF between exacerbations	• ≤ 2 times/month	• FEV_1 or PEF ≥ 80% predicted • PEF variability < 20%	Quick Relief • Inhaled short-acting $beta_2$-agonist PRN Long-Term Control • Usually no daily medication needed [B-p]
Mild Persistent [C-p]	• Symptoms > 2 times/week but < 1 time/day • Exacerbations can affect activity	• > 2 times/month	• FEV_1 or PEF ≥ 80% predicted • PEF variability 20-30%	Quick Relief • Inhaled short-acting $beta_2$-agonist PRN Long-Term Control • Inhaled corticosteroid (LOW dose) • May also consider theophylline SR, leukotriene modifier, cromolyn or nedocromil • For patients with ASA sensitive asthma, consider using leukotriene modifiers [D-p]
Moderate Persistent [E-p]	• Symptoms daily • Exacerbations ≥ 2 times/week and affect activity • Daily use of quick relief meds	• > 1 time/week	• FEV_1 or PEF ≥ 60% < 80% predicted • PEF variability > 30%	Quick Relief • Inhaled short-acting $beta_2$-agonist PRN Long-Term Control Either: • Inhaled corticosteroid (MEDIUM dose) Or • Inhaled corticosteroid (LOW-MEDIUM dose) & Inhaled long-acting $beta_2$-agonist Or • Inhaled corticosteroid (LOW-MEDIUM dose) & theophylline And: • Consider using leukotriene modifiers Consider referral [F-p]
Severe Persistent [G-p]	• Symptoms continuous • Limited physical activity • Exacerbations frequent	• Frequent	• FEV_1 or PEF < 60% predicted • PEF variability > 30%	Quick Relief • Inhaled short-acting $beta_2$-agonist PRN Long-Term Control Either: • Inhaled corticosteroid (HIGH dose) & Inhaled long-acting $beta_2$-agonist Or • Inhaled corticosteroid (HIGH dose) & theophylline And: • Consider oral corticosteroids • Consider using leukotriene modifiers Consider referral [H-p]

* Lung Function criteria for defining asthma severity level *only* apply to adults and children 6 and over who can perform spirometry or use peak flow meters

DOD/VHA CLINICAL PRACTICE GUIDELINE FOR THE MANAGEMENT OF

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